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DEVELOPMENTS IN THE SOUTH STAFFORDSHIRE IRON AND STEEL  
INDUSTRY, 1850 - 1913, IN THE LIGHT OF HOME AND FOREIGN  
COMPETITION.

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Abstract: DEVELOPMENTS IN THE SOUTH STAFFORDSHIRE IRON AND STEEL  
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COMPETITION.

When Ebenezer Parkes was discussing the question of foreign competition as it affected the local iron and steel industry at the turn of the century, he stressed that it was a 'many sided thing'. Besides, if South Staffordshire was to reassert itself, then improvements would have to come about in a number of areas - in education, use of labour-saving machinery, practices in the blast furnace and rolling-mill departments, labour relations, canal and rail transport, structure of industry, state support and Colonial trade. This thesis is an attempt to look at the various 'sides' of the South Staffordshire iron and steel industry as it faced up to increasing competition both from other United Kingdom districts and from abroad. The importance of physical factors is considered in conjunction with human ones.

Clearly, South Staffordshire could do nothing to prevent the growth of new centres of iron and steel production; furthermore, other older centres of production, notably South Wales and Scotland, fared better in the second half of the nineteenth century because of their tidal locations. Iron ores from Spain or steel 'semis' from the United States or the European Continent tended to emphasise the shift away from a land-locked centre of production. Abroad, tremendous growth was experienced by the iron and steel industries of the United States and Germany, a development which made all the apparent disadvantages of South Staffordshire appear that much more significant. Of these disadvantages, South Staffordshire's almost total dependence on outside supplies of metallurgical coke ranks very high. So, too, do the numerous shortcomings of the transport facilities of the area. On the human side, the failure of the local ironmasters to take full advantage of the proximity of East Midland iron ore supplies was

crucial. Their reliance upon outside supplies of iron ore, which remained largely out of their control, put them in sharp contrast with producers on the Continent or in the United States.

To add to the difficulties being experienced by the local industry, Birmingham and the Black Country proved a very attractive market for foreign producers. The so-called 'dumping' policies of the Americans and Continentals are pursued at some length in the last chapter.

Despite the many changes which took place in the district, South Staffordshire remained a very important part of the United Kingdom iron and steel industry. The fortunes of Round Oak, and especially those of Sir Alfred Hickman's Spring Vale Works, illustrate the fact that overall the situation in South Staffordshire was never a totally hopeless one.

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## Introduction.

In presenting an account of the South Staffordshire iron trade in the period 1850 - 1913, I am conscious of the fact that aspects of the subject have been told time and again. In one sense, this is proof of the importance of South Staffordshire's position. Too often, however, people writing about the district have done so solely from the point of view of local history, sometimes from local pride. Consequently, an inadequate and incomplete account has been given, with wrongly placed emphasies on the causes of change or decline resulting. By looking at events in South Staffordshire against the background of growing foreign competition, it is possible to gain a more balanced and accurate picture. Indeed, South Staffordshire had for years occupied a very important position in the international iron trade; this was as true in 1900 as it had been in 1850, although, inevitably, the nature of the position had changed enormously. The reasons for this change were many - they concerned 'the employer, the workman, the scientist, the engineer, the Consul, the British agent, and last, but not least, 'the Government of our country'(1) - and to a very great extent, indeed, there was little that South Staffordshire could have done to have influenced the changing situation.

Originally, the local iron industry of South Staffordshire was based on the availability of easily accessible raw materials - iron ore, coal and limestone - and a very adequate canal system. Rapidly, after 1850, the district lost these advantages: first, the ore was either worked out or became too expensive to mine, followed soon afterwards by the exhaustion, or loss through flooding and careless mining methods, of the best coal seams; secondly, the canal system, upon whose banks the great majority of works were situated, together with the railways, proved

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(1) Ebenezer Parkes, Foreign Competition, Proc. S. Staffs., 1901 - 2, pp. 84 et seq.

increasingly inadequate and expensive as far as the ironmasters were concerned. It is only when a detailed look at the management of the railway/canal system is taken that these shortcomings emerge in their entirety. Besides, no transport system could have surmounted all the disadvantages of an inland location. In the face of these growing difficulties, there was an obvious human failure. For whatever reason, the majority of ironmasters proved unable to react positively to the changed circumstances. That a minority did so only goes to show that the overall situation in South Staffordshire was, at no stage, a totally hopeless one. Sir Alfred Hickman, a man surprisingly neglected by writers on the local scene (one eye-witness account of Hickman's funeral spoke of 50,000 people lining the streets of Wolverhampton to pay their last respects), survived every disaster which hit the district, and his steelworks at Bilston remain in operation to this day as part of the British Steel Corporation.

Clearly, South Staffordshire could do nothing to prevent the growth of new centres of iron production in the the United Kingdom, chief of which was the north-east. Older centres, notably South Wales and Scotland, also fared better because of the near-tidal locations. When the local South Wales iron ores became exhausted, the district's ironmasters were in the position to receive cheap ore from Spain. Similarly with the finishing departments; steel semis were imported into South Wales in ever-increasing amounts and sold to the local re-rollers at a price which did not include the cost of transit to the sheet producers, etc. in the Black Country. Abroad, tremendous growth was experienced by vigorous new industries in the United States and Germany. All the disadvantages of South Staffordshire appeared that much more significant in the light of the progress made in the United States and on the Continent. Changed physical conditions, together with totally different politico-economic systems, inevitably

altered the nature of the world's leading iron and steel industries. When Ebenezer Parkes was discussing the problem of foreign competition at the turn of the century he stressed that it was a "many sided" thing. If South Staffordshire and, for that matter, the United Kingdom industry as a whole, was to reassert itself, the following trends would have to come about: better education, primary, secondary, technical; utilisation of labour-saving machinery; improved practices in the blast furnace and rolling mill departments, especially by the use of electricity; better understanding, and greater freedom and cooperation between managers and men; better trained managers and greater push and hard work on the part of the masters; payment by results; greater sobriety amongst the men; improvement of canals and waterways; lower railway rates and better railway management; the adoption of the trust structure; Protection and the growth of closer trading links with the Colonies. My thesis, indeed, consists of an attempt to look critically at these various 'sides'. The final chapter is an account of the nature of foreign competition as it was felt in South Staffordshire; it shows just how much the district had become dependent upon imported steel semis and that without the so-called "economic dumping" by the Americans, Germans and Belgians the finishing departments would have found things even more difficult.

My sources for this thesis include some primary material which has not previously been used, especially the documentary evidence relating to the firm of Alfred Hickman, Limited now in the possession of the British Steel Corporation. Other interesting material came from the offices of Patent Shaft (1969) and Bradley and Foster (1969); the Minutes Books of the Wolverhampton Chamber of Commerce were of considerable importance, as were the 'Accounts Books' of Lloyds, Fosters and Company and Alex. Smith's 1897 Valuation of the Round Oak Iron and Steel Works.



## Chapter 1 The Structure of the Iron and Steel Industry.

Although there were examples of fully integrated works to be found at various stages in the development of the industry, it is perhaps preferable to separate the various departments of the Black Country iron trade for individual attention. Four major departments are considered:

blast furnace operators,  
wrought iron manufacture,  
steelworks,  
finished iron and steel.

As will become clear in the narrative, whilst there was a certain homogeneity about the Black Country iron trade, it was also the case that the fortunes of the various departments were not the same. Very simply, the rise of the steelmaking industry in the Midlands came in a period of rapid decline for the wrought iron sector. The finishing departments often experienced spells of steady progress whilst the smelters and bar iron makers were suffering from outside competition.

### The Pig Iron Department.

By the middle of the nineteenth century, pig iron production in the Black Country was centred chiefly on Bilston (42 blast furnaces built) and Dudley (40 blast furnaces), although there were smaller areas of some importance. To some extent, these details added up to a shift away from the Tipton area (21 blast furnaces); in 1823, for example, whilst the Bilston area accounted for 30 per cent of the total pig iron output of the Black Country, Tipton had produced 25 per cent, but seven years later this had fallen to 17 per cent. No blast furnaces were located off the coalfields and both West Bromwich and Smethwick, whilst being important centres of the finishing trades, possessed few pig iron manufacturers. No fewer than 55 different firms were engaged in the production of pig iron in the district, many of which were similar in every aspect. In size, the average blast furnace plant con-

sisted of two or three furnaces; Izons and Company (Izons Furnace) and S. Evers and Sons (Parkhead) were two firms which possessed only one furnace and are scarcely worth mentioning.(1) A small number of firms were, in fact, in possession of more than five furnaces, but in the mid-century Black Country this was because they owned two or more separate units. Later on, indeed, there were examples of single plant having six blast furnaces - Hickman's Spring Vale Works at Bilston for one. The Earl of Dudley in 1860 possessed no fewer than seven blast furnaces, four at the New Level works, Brierley Hill, and three at Coneysgre, Tipton. The Chillington Iron Company, whose Wolverhampton works were designed by John Urpath Rastrick, also had seven blast furnaces, four at Chillington and three at Moseley Hole. In addition to the Earl of Dudley's large concern, the southern half of the district had a number of other very important works, notably the Old Hill Works (Badgers), New Corbyn's Hall (Gibbons') and Old Level (Hall, Holcroft and Pearson). In the northern part, J. Bagnall, with the Goldshill Ironworks and mines in the Great Bridge-Tipton district and the Capponfield works and various other mines, was most important.

In the 1840's, the pig iron department had experienced very mixed fortunes and prices had fluctuated wildly.(2) In 1841, for example, pig iron was fetching £5 per ton, but within less than two years this figure had fallen to 50/-. By 1846, following a brief period of intensive railway building, pig iron had again reached £5 per ton, although it was clear that the Black Country was not enjoying the same degree of prosperity as elsewhere in the United Kingdom. One reason for this was that the district could not compete with South Wales in the manufacture of

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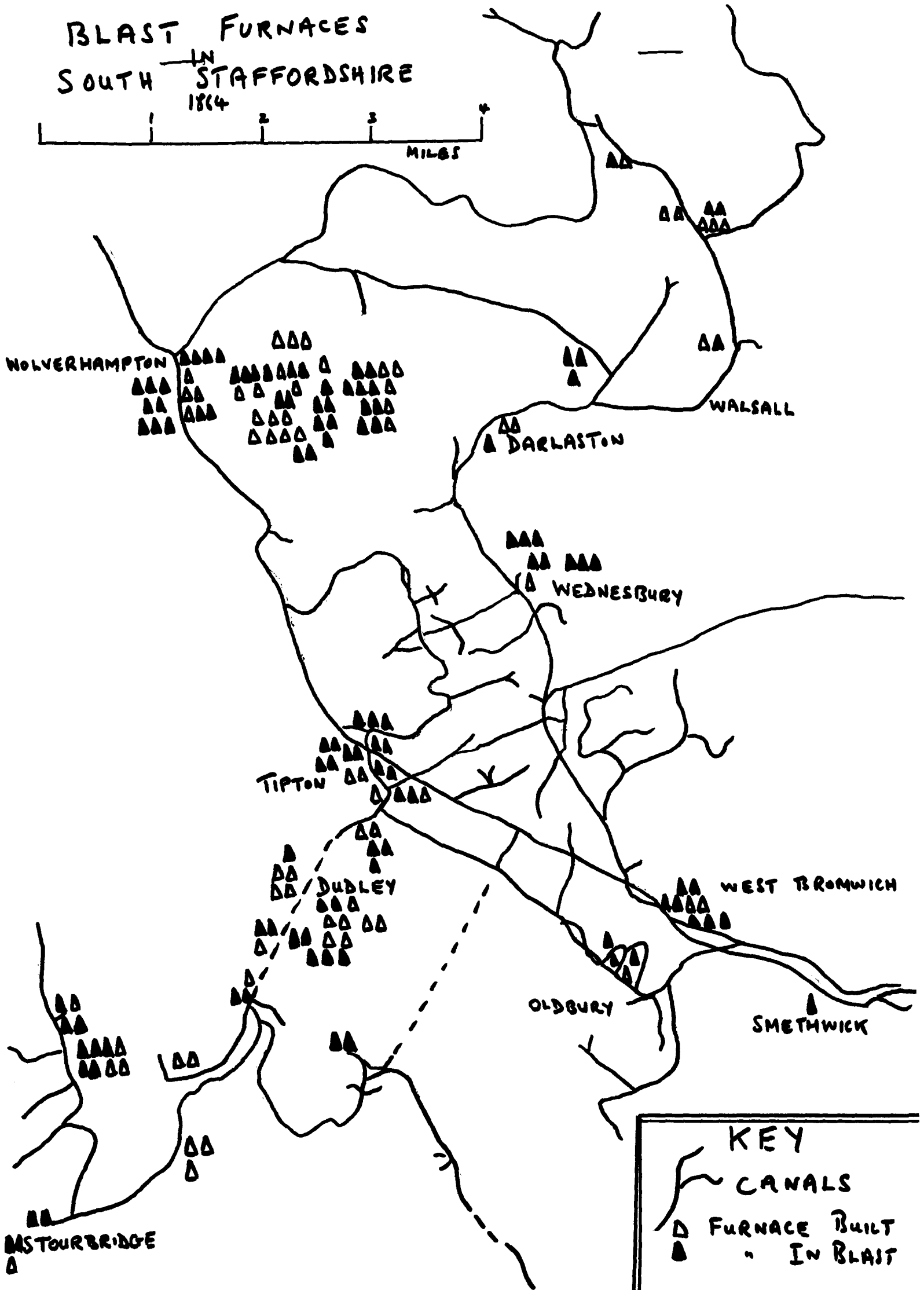
(1) W.K.V. Gale, The Black Country Iron Industry, 1966, p. 77.

(2) G.R. Morton & M. Le Guillou, The Rise and Fall of the South Staffordshire Pig Iron Industry, The British Foundryman, vol. LX, Part 7, July 1967, p. 277.

# BLAST FURNACES IN SOUTH STAFFORDSHIRE 1864



MAP 1.



## KEY

- CANALS
- △ FURNACE BUILT
- ▲ " IN BLAST

iron rails. Trade improved greatly in the early 1850's, and in 1852, 127 of the 159 furnaces in the district were in blast producing 725,000 tons of pig iron. Building of new furnaces went on in an attempt to meet the ever growing demand for iron. Pig iron prices rose, to settle around £6 per ton, and for almost the last time in the history of South Staffordshire pig iron production all but a small percentage of the existing furnaces were in blast:

<u>Year</u>	<u>No. of furnaces built</u>	<u>In blast</u>	<u>Tonnage</u>
1854	175	145	743,600
1855	178	146	754,000
1856.	171	147	777,171
1857	180	153	657,195

The national crisis of 1857, whilst short-lived, greatly disrupted the trade of the district, and by this time leadership in blast furnace practice was clearly passing to the Cleveland district, whence came severe competition. Numerically, however, the Black Country did not reach its peak in terms of blast furnaces built until 1863, although of the 200 furnaces said to be in existence by Jones in that year only 110 were actually in blast.(3) Indeed, the figure of 200 is very misleading because included in that number were many furnaces dating back to the Wilkinson era which were simply not capable of producing pig iron to sell at the prices which prevailed in the 1850's and 1860's. In one sense, nearly 50 per cent of the productive capacity of the area was inoperative. Professor Allen has termed this the "surplus capacity" of the Black Country which came into use only in short periods of very active trade. It was a legacy of the earlier prosperity of the district and "could not be worked profitably during the lean years".(4) In fact, quite a number of the older furnaces were scrapped in the 1860's and 1870's, an example being the "Hot Holes", or the "Bilston Blast Furnaces",

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(3) S. Timmins (ed.), The Birmingham and the Midland Hardware District, 1886, section on the Iron Trade by J. Jones, pp, 65 et seq.

(4) G.C. Allen, Industrial Development of Birmingham and the Black Country, 1929, p. 195. See also the graph on page 5a of this script for a pictorial presentation of Allen's "surplus capacity".



bought by Alfred Hickman in October 1866 from John Jones.(5)

For much of the 1860's, there were bursts of prosperity followed by short depressions. After two fairly satisfactory years, 1866 was something of a crisis year for the district for by the end of it only 92 out of the 170 furnaces built were in blast. Strikes and lock-outs be-devilled the industry, and at least two blast furnace units disappeared for good, Russell Hall and the Oak Farm works. Perhaps the most notable failure of this period, although the blast furnaces were afterwards continued in operation by the new owners, was that of Lloyds, Fosters and Company, owners of the Old Park Furnaces, Wednesbury. The main bulk of the pig iron produced at Old Park had been consumed by that company, which still had to 'import' large amounts from outside the district. In 1863, for example, Lloyds, Fosters and Company consumed 16,474 tons of pig and 14,206 tons in the following year; of these amounts, 11,460 and 7,188 tons came in from outside the district in 1863 and 1864 respectively.(6) In fact, it cost the company more to produce its own pig iron - £3/10/2 to £3/17/5½ - than it did to purchase supplies from elsewhere at £3/9/8½ and £3/12/9¼. Another pig iron producer to go out of business about this time was the family concern of the Gibbons', owners of works at Millfields, Ketley and Level; very little was done by the family after the death of Benjamin Gibbons in 1865. The state of the iron trade in 1868-69 was described by Griffiths as "as flat ... as can well be remembered"(7), but in the very next year the Black Country was caught up in the excitement of a boom. Prices of pig iron rose sharply and in December 1871 an average quality pig iron cost £5/10 per ton in the district, hot air all-mine pig £8 and cold-blast pigs touched £9 to £9/10. Production of pig iron stood at 728,000 tons and amounted to

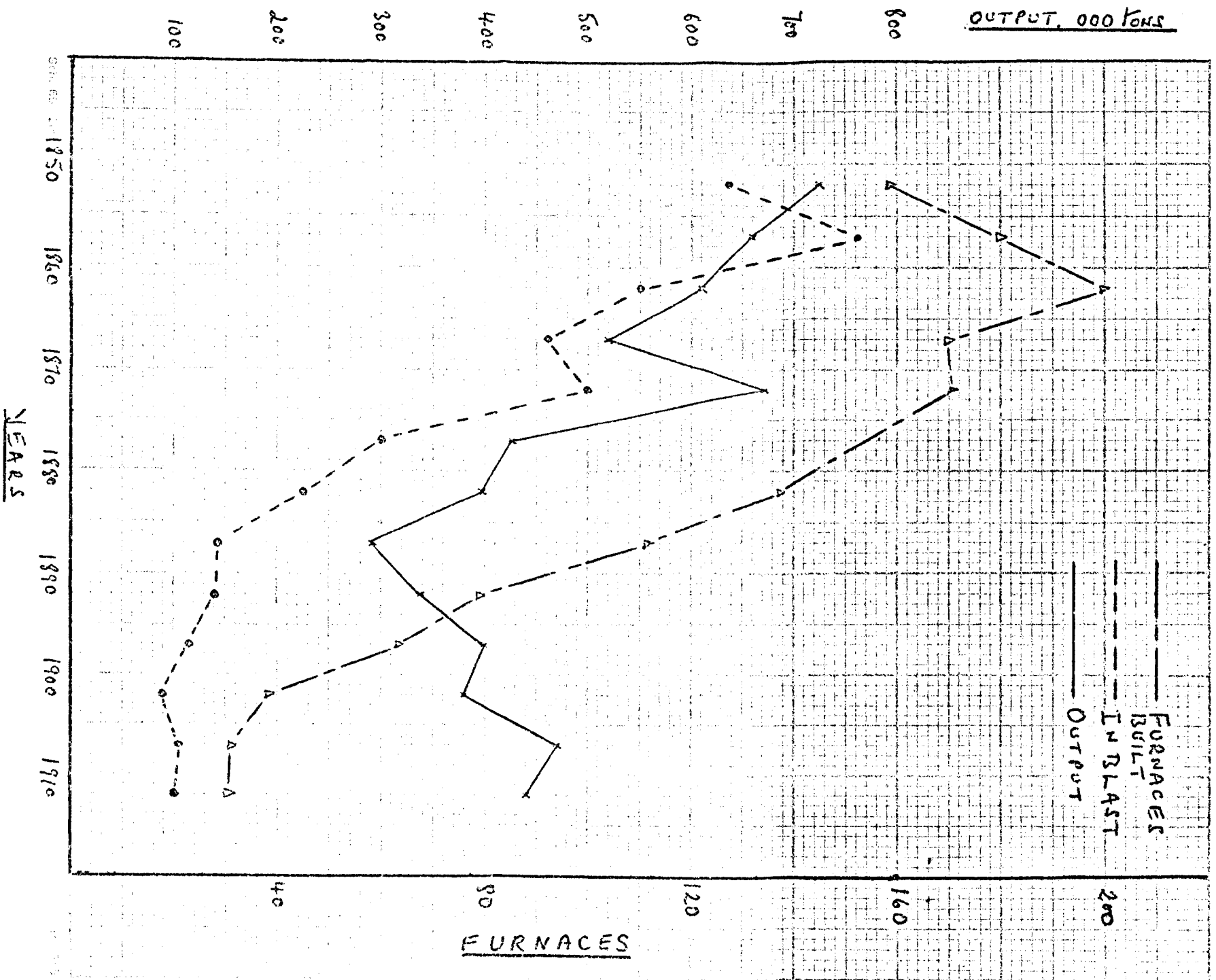
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(5) G.R. Morton & M. Le Guillou, Alfred Hickman Ltd, 1866 - 1932, Journal of West Midland Studies, vol. 3, 1969, p. 5.

(6) Accounts Books, Lloyds, Fosters & Co., entry for June 1865.

(7) H.W. Griffiths, Guide to the Iron Trade of Great Britain, pp. 12-13.

# FURNACES + Production 1850-1912



nearly 11 per cent of the total British output. 114 furnaces were then in blast, but the following analysis of the district hints at a

disturbing point:	<u>Area</u>	<u>Percentage of furnaces out of blast</u>
	Wolverhampton	50
	Bilston	20
	Wednesbury	36
	Tipton	23
	Oldbury	50
	West of Dudley	30

Over the entire district, something like 41 per cent of the furnaces (100.5 out of 171) were lying idle even in this period of feverish activity.

Despite the general insecurity which seemed to characterise the district's smelters after the boom of 1871-73, the period did witness the start and subsequent growth of the firm belonging to one of the district's leading ironmasters of the years 1889 to 1910, Alfred Hickman. By the mid-1870's, Hickman was making a variety of pig irons, the quality of which depended upon the combination of ores placed in the blast furnace. For the best quality mine pig the mixture was made up of six skips Mine, two Pottery and one Northampton (Muck), whilst the charge for the production of common pig was pottery, Northampton and Taps. The Spring Vale Works was slowly building up a very good reputation for both Hydrate Iron ("S.V.H. hydrate") and the Bilston Furnace Mine ("B.F.M. all-mine"). In 1880, the monthly make of pig iron from Hickman's four furnaces was as follows:

Furnace Nos. 1 & 3	<sup>*</sup> Common, made from Pottery, Northampton and taps. This iron contained 3 per cent of phosphorus and was used mainly for making tubes for the gas industry.
Furnace No. 2	Hydrate Iron, made from red or brown hydrate ore from the Churnett Valley in North Staffs., Pottery and a little 'flue' (flue dust). It was used for making best marked bars of wrought iron, which contained less than 0.75 per cent of phosphorus.

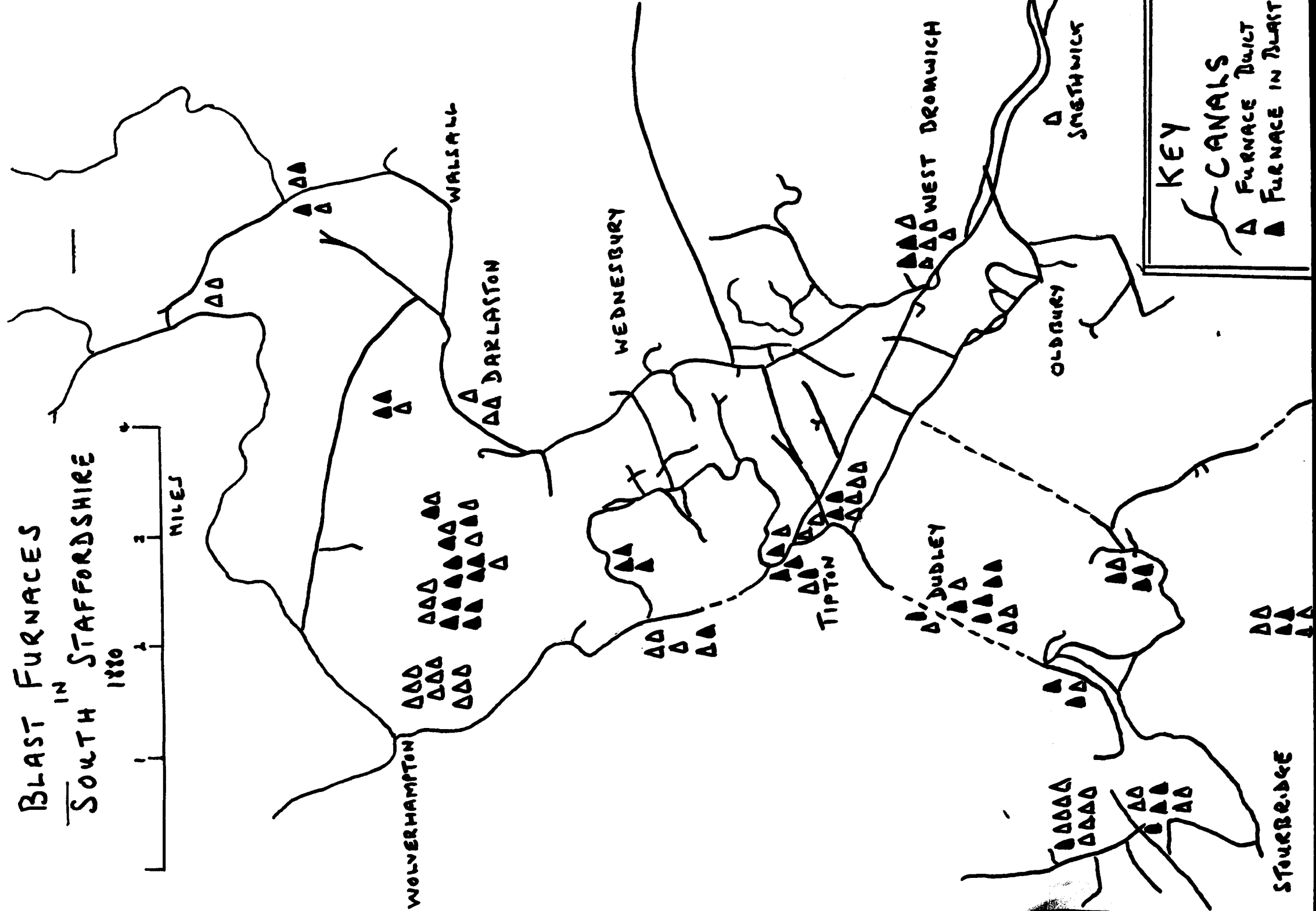
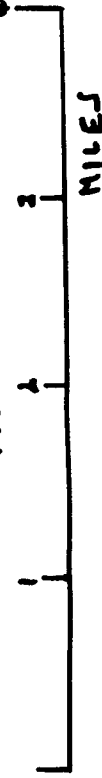
\* See Glossary of Black Country terms at end of thesis.



# BLAST FURNACES

SOUTH IN STAFFORDSHIRE

1880



Furnace No. 4      Bilston Furnace Mine, which was made from Flue, Pottery and Northampton ores. It was used for manufacture of good unmarked wrought iron bars.(8)

Elsewhere in the district, the makes of pig iron were much the same, although each firm tried to establish for itself a certain reputation for one or more of the better qualities of pig:

Main Types of Pig Iron Made in Black Country

Staffordshire cinder (forge & foundry)  
part-mine  
all-mine (ordinary & best)  
cold blast

I. & J. Bradley, for example, had a very good reputation for their Capponfield forge pig and their Darlaston foundry pig, although not in the same class as those made at the Spring Vale works.

In 1881, cinder pig was selling in the Black Country for 35/- a ton (9), whilst common foundry cost between 37/6 and £2 a ton to make.(10) Such prices left very little room for profit; nevertheless, except in brief periods of severe depression, the locally produced pig iron found a ready

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(8) The Ingot (newspaper of Alfred Hickman Ltd.) vol. 1, No. 1, July 1919, p. 7. See Glossary for definition of terms used.

(9) Select Committee on Railways, 1881, M.E. 4467.

(10) Production costs varied enormously in the Black Country, much depending on the price of coke and ore, as well as wages. Hickman's costs for 1866 and 1873 were as follows:

	1866			1873		
	Mine		Common	Mine		Common
	£	s d	£ s d	£ s d	£ s d	£ s d
Coal	15	6½	15 0½	1 10 7¼	2 0 1¼	
Materials	14	11½	10 0	2 12 5	15 0	
Lime	3	5	3 5	2 10½	2 10½	
Wages	7	8½	7 8½	9 10¼	9 10¼	
Sundries	6	7¾	6 7¾	8 3¼	8 3¼	
Total	3	8 3	2 5 9½	5 3 11¾	3 16 0¾	

market in the district. Hickman correctly informed the 1881 Select Committee that although Cleveland production costs for foundry pig were about 38/- it cost a further 12/- to transport the pig to the Black Country; this left the district's producers, despite their complaints about high production costs, a fair amount of leeway in which to operate.

Disappearing Works in the Black Country. (See Maps 1,2 & 3).

<u>Year</u>	<u>Firm</u>
1870	Oak Farm Ironworks (Glynne & Co.)
1870	Edward Cresswell & Sons, Tipton
1875	Messrs. Evers & Martin
1876	Bloomfield Ironworks (Barrows & Hall)
1877	Dudley Port (J. & G. Onions)
1879	Tipton Grange Ironworks (Barrows & Hall)
1879	J. Bagnall's works at Tipton and Wednesbury closed (West Bromwich works continued)
1881	Furnaces of Earl of Dudley, formerly leased to Messrs. Evers & Martin, dismantled
1882	Jones Brothers
1882	Darlaston Iron & Steel Company
1883	Monway Ironworks (J. Marshall)
1884	Chillington Ironworks
1886	David Rose of Moxley
1886	Messrs. John Rigby & Sons
1887	Bromford Ironworks (John Dawes) unsuccessfully put up for auction
1894	New British Iron Company, Ltd. (Corngreaves Ironworks, Cradley Heath)
1897	Gospel Oak Iron Company
1909	Failure of Benjamin Bunch & Sons, Walsall (owners of Bloomfield Ironworks)
1911	H.B. Whitehouse & Sons, Ltd., Tipton.

By the late 1880's, a much greater threat to the Black Country smelters was coming from the blast furnaces situated in neighbouring counties, especially those in Northamptonshire, Derbyshire and Lincolnshire. The first 150 tons of pig iron made in Wellingborough in 1863 were, after some hesitation, purchased by a Black Country firm, Messrs. Hipkins of West Bromwich, and from that point on the flow of Northants pig iron to South Staffordshire increased.(11) Much of the early pig came into the district by canal (Junction & Oxford and Coventry Canals), 1600 tons

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(11) Mining Journal, 1/2/68.

being sent by this method of transport in 1856. In the period of expansion for the Northants industry, 1864-73, the L&NWR, in fact, carried substantial quantities of pig iron as well. The South Staffordshire iron trade tended to display this early preference for Northants pig rather than the ore. Production costs in these experimental years for the Northants smelters were lower than in the Black Country; good rail facilities enabled Durham coke to be used in the blast furnaces, with the result that in 1859-60 when the production costs in South Staffordshire were about 64/- per ton, Northants pig could be made for 45/-. By the early 1890's, in fact, Black Country blast furnace proprietors were extremely anxious at the way the 'newer' centres were competing with them.

With a greatly reduced number of blast furnaces, the Black Country was still producing the same variety of pig irons as in the earlier years, and separate prices were quoted for each of the local varieties, in addition, the three main markets of the Black Country, Dudley, Wolver-

South Staffordshire Blast Furnaces, 1892-1912.

<u>Year</u>	<u>No. Built</u>	<u>No. in Blast *</u>
1892	79	29
1893	79	25
1894	76	22
1895	69	21
1896	69	23
1897	63	23 {26 in March}
1898	60	23 {25 in March}
1899	59	22
1900	47	20
1901	43	18 (16 in March)
1902	39	18
1903	37	19
1904	37	16
1905	39	18
1906	32	18
1907	31	21
1908	34	18
1909	34	21
1910	34	19
1911	30	19
1912	31	20 (June)

\* 30 September each year

hampton and Birmingham gave separate quotations for 'Lincolns', Northants and Derbyshire pig irons.

Prices of Pig Irons Quoted In Wolverhampton, January 1893.

<u>Type</u>	<u>Price</u> (per ton)
'Lincolns'	48/6 - 48/9
Northants	43/-
Derbyshire	44/-
Staffs. cinder	36/-
Part-mine	44/- - 45/-
All-mine {hot blast}	60/-
" " {cold " }	95/- - 100/-

Competition for sales of pig iron in the Black Country had entered a bitter stage in the early and mid-nineties: local producers, throughout 1893, 94 and 95, were often forced to blow out one or more of their furnaces rather than permit stocks to build up which merchants would then take only at reduced prices. Only 18 furnaces were actually in blast in April 1894, and the sole reason for this poor state of affairs was the competition from smelters in Northants and Derbyshire. Agents were then offering pig iron from those two counties at only 37/- and 37/6 per ton, whereas local producers could not ask less than 40/- for pig iron of similar quality (forge). Eight of the furnaces in blast were either fully engaged in producing pig iron for steelmaking or were making cold blast pig. Staffordshire cinder pig, momentarily, had disappeared from the markets and was superceded by 'imported' makes. With Northants makers having to pay at least 5/- per ton carriage on the pig iron sent into the Black Country, it was clear that their production costs had been greatly reduced. As far as South Staffordshire was concerned, it was a case of the Northants blast furnaces being located nearer to the iron ore. By May 1895, with sales of Derbyshire and North Staffordshire pig up on previous totals, the Black Country was reported to be importing at least two-thirds of the quantity of crude metal consumed, i.e. about 710,000 tons per year.

In 1896, the pig iron department at last showed signs of improvement, although not to the same extent as some sections of the finished iron

department. In the early part of the year, weekly production was maintained at around 6,000 tons, with very little metal going into stock.

Pig Iron Production in South Staffordshire, 1894-99.

<u>Year</u>	<u>Tonnage</u>
1894	315,924 * (35,532 in stocks)
1895	353,333 * (22,329 " " )
1896	308,459
1898	332,869
1899	338,283

\* includes Worcs.

Production of cinder pig had recovered some of its lost importance, and the good quality South Staffordshire part-mine was holding its own against both Northants and Derbyshire pigs. The decline in the number of "list houses" in South Staffordshire and East Worcestershire meant that there was a much lower local demand for all-mine pig with a resulting lowering in price in relation to other varieties. As trade continued to improve in the last quarter of 1896, there was much speculation as to just how many blast furnaces would be blown in by the end of the year; in fact, the number rose to 23. By March 1897, 26 furnaces were in blast, the last time in the history of the Black Country that the total exceeded 25. All the Midland districts were doing well, as the following table indicates:

Number of Blast Furnaces in Midland Districts, 16/10/98.

<u>District</u>	<u>Built</u>	<u>In blast</u>
Northants	26	13
Lincolnshire	21	14
Derbyshire	52	34
Shropshire	10	5

It was clear to contemporary observers that the Black Country had survived the phase of severe competition from the neighbouring counties fairly well although, inevitably, there had been casualties. The Gospel Oak Iron Company actually went in 1897, the first year of recovery. The largest casualty of the 1890's, however, was the New British Iron Company, Limited, of the Corngreaves Ironworks, Cradley Heath in 1894.(12) The

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(12) Catalogue of Sale of Plant, quoted by W.K.V. Gale, op cit, p. 117.

sale of plant took place in June 1894, and it was estimated by a contemporary ironmaster, Jno. W. Hall, that "the proprietors lost half a million of money". A few years earlier, the New British Iron Company had possessed six blast furnaces, but only two of which (the New Plant furnaces) had been of modern Black Country design. Obviously, too, some of the furnaces which remained out of blast in the district were obsolete and would never be blown in again, but it is interesting to note that in May 1897 two improved furnaces at Tipton, belonging to Messrs. Roberts and Company, were reported to have produced 825 tons in one week - "probably the largest output recorded in the Black Country". Furthermore, a large new blast furnace was then under construction for the Earl of Dudley at his Level Works, Brierley Hill.(13) In that year the following firms were still engaged in the production of pig iron: G. & R. Thomas, the Earl of Dudley, Messrs. Hingley and Sons, Messrs. Whitehouse & Sons, Sir Alfred Hickman, P. Willis & Son, the Willingsworth Iron Company, Messrs. Grazebrooks, Cochrane, J.H. Pearson, Roberts & Company, Tipton, Bassano, Barbor's Field Works and Dudley Port Furnaces.(14) In addition, there were the furnaces at Capponfield and Darlaston.

Throughout the next few years, the Black Country pig iron department experienced near boom conditions; in 1898, it was agreed by the blast furnace proprietors that production had once more become a profitable business. The weekly output of around 7,000 tons was quickly snapped up and the wharves of the smelters were reported to be "bare of stock". In November 1899, prices for all types of pig iron were realising the highest levels for twenty-five years(15), and even the lowest quality

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(13) Colliery Guardian, 7/5/97.

(14) The last three were definitely out of operation in December 1903.

(15) Colliery Guardian, 17/11/99.

of pig metal had risen from under £2 to over £3. Nevertheless, there was not a great deal of expansion in the local industry, despite the fact that well over 7,000 tons of pig iron had to come in from other Midland districts each week. This inability of the local producers to meet the requirements of local consumers was obviously a very serious weakness and had disappointing repercussions for the other sections of the Black Country iron trade. Finished iron manufacturers were hampered by delays in delivery of pig iron, and in periods of full demand they stood little chance of early supply unless they had been old customers of the smelters. Besides, artificially high prices for pig iron, whilst naturally pleasant to the smelter, meant that common bar makers, faced with still higher production costs, were less able to compete with the industries in Europe and the United States. Apart from the steel makers, only two firms were prepared to risk capital and take the opportunity of high prices to expand. In November 1899, Thomas Cooper, of Bradley, and F.D. Docker, of Birmingham, purchased the new Priestfield furnaces at an auction, formerly owned by Messrs. W. Ward and Sons, whilst a few months earlier James Sparrow had restarted one of his Ffriad blast furnaces at Wrexham which had been standing idle for ten years. Neither venture survived very long after 1900. One of the most notable features of this boom period was the heavy demand for Staffordshire cinder pig for forge purposes, production of which had earlier almost ceased.

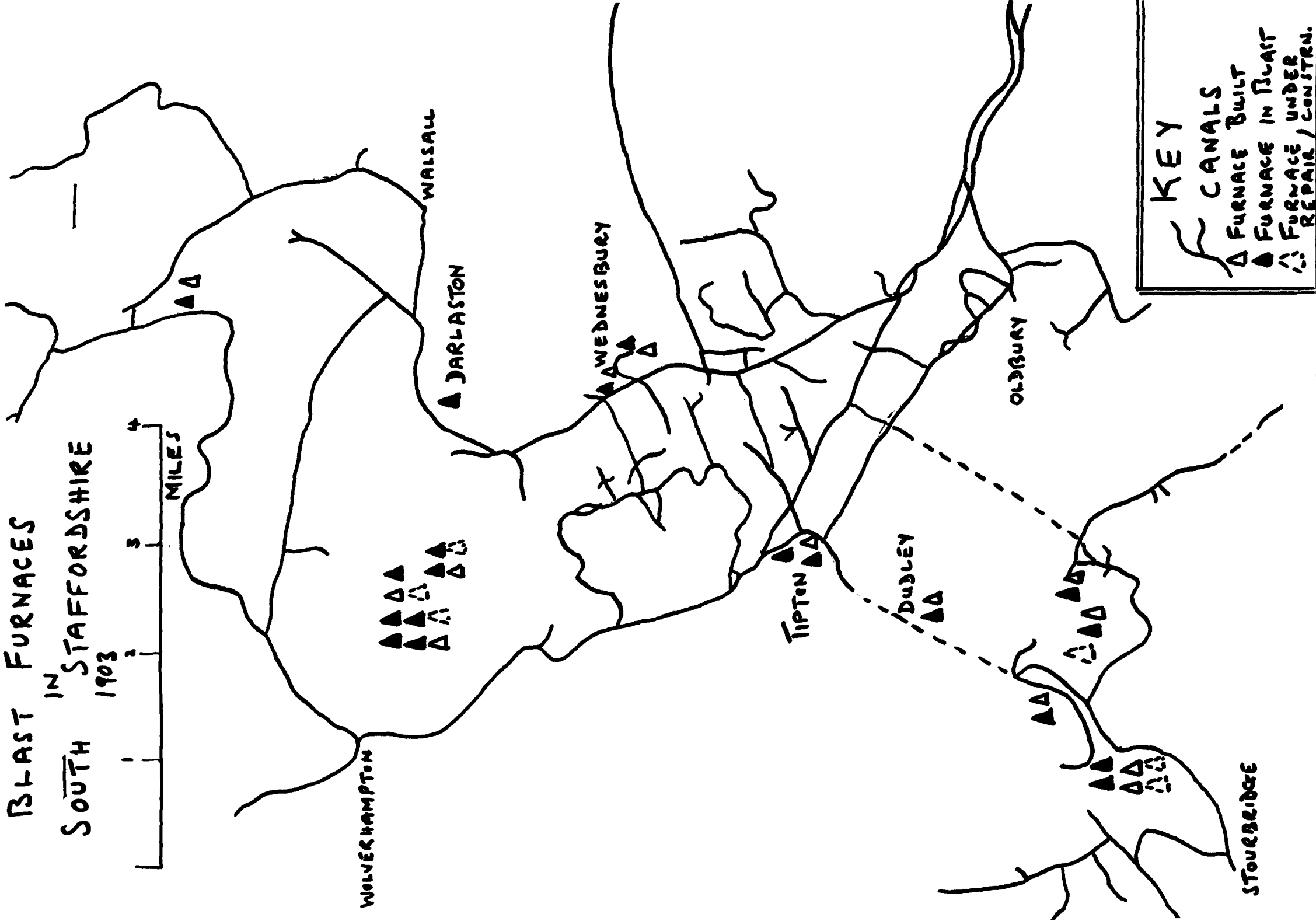
Significantly, the first signs that the pig boom was coming to an end came when the Black Country markets were disturbed by news of the unsettled markets for Scotch and north of England warrants. The favourable situation deteriorated rapidly and even large producers like Patent Shaft decided to cut back on the production of pig iron and their Willenhall furnaces were blown out in October 1900.<sup>(16)</sup> The total number of furnaces

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(16) Colliery Guardian, 19/10/1900.



# BLAST FURNACES IN SOUTH STAFFORDSHIRE 1903



KEY

CANALS  
 FURNACE BUILT  
 FURNACE IN BLAST  
 FURNACE UNDER REPAIR / CONSTR.

in blast in the district fell to 18 (as against 23 a few months before), and two more had been put out by June 1901. One or two blast furnace proprietors had allowed their stocks of pig iron to grow rather than blow out a furnace, but others had taken the opportunity of the lull in demand to repair and modernise their furnaces after what had amounted to a period of very hard driving. This situation had the effect of creating temporary shortages in supply, and complaints of irregular delivery were reported from a number of consumers.(17)

With the partial recovery in the fortunes of the iron trade elsewhere in the country in 1902, Black Country smelters proved sluggish in meeting the increased demand for pig. There was a serious scarcity of pig iron reported in August and September 1902, with the result that various manufacturers complained that they would be unable to withstand foreign competition even more, especially as the prices of what pig iron actually came on to the market had risen sharply. Not until October were supplies of pig iron in the district equal to demand, and even then there was very little room for manouvre. As had happened so often in the past, demand for pig iron was not sustained and by May 1903 the market was reported to be "less buoyant". By the last quarter of the year, the situation was extremely dull and the number of furnaces standing idle was thought to be the largest for a considerable time. One observer wrote:

"... a great deal of the plant is antiquated and might well be dismantled but few ironmasters have sufficient faith in the future to incur the expense of re-modelling".(18)

Over the next few years, the pig iron trade continued with its ups and downs, but it would be wrong to give the impression that very little

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(17) Colliery Guardian, 14/6/01.

(18) ICTR, 5/1/04.

District Break-down in State of Blast Furnaces, December 1903.

<u>Name</u>	<u>In Blast</u>	<u>Out</u>	<u>Total</u>	<u>Building/Repair</u>
Capponfield	1	1	2	1
Darlaston	1	—	1	—
G. & P. Thomas	1	1	2	—
E. of Dudley	2	2	4	2
Hingley & Sons	1	1	2	—
Whitehouse & Son	2	1	3	1
Sir. A. Hickman	4	1	5	1
P. Willis & Son	1	1	2	—
Willingworth Iron	1	1	2	—
Grazebrooks	1	1	2	—
Cochrane	1	1	2	1
J.H. Pearson	1	1	2	—
Roberts & Co.	2	1	3	—

(only firms with at least one furnace in blast included)

was happening to this sector. In some respects, the period from 1905 to 1914 saw the Black Country smelter at his most efficient (see section on technological progress), for those who had survived into the Edwardian years were the most forward-looking of the nineteenth century ironmasters. The district's two large steelworks, Round Oak and Spring Vale, were spending large amounts of capital on expansion and modernisation programmes as, indeed, on a smaller scale, were T. and I. Bradley, Ltd., and H.B. Whitehouse and Sons, Ltd.. Those works which had not gone over to steel production, and clearly they were in the majority with regard to furnace proprietors, found things harder. With the change-over from iron to steel in the finishing trades well advanced by 1903-5, the number of firms engaged in the manufacture of bar iron had greatly declined. High-class foundry pig for railway castings nearly always commanded a high price, with the result that a few blast furnace proprietors were able to find a good market for their cold blast and hot air all-mine pigs. The local chilled and grain roll makers, for example the Stonehouse Works, Ltd., of Perry Bar, were customers for this high-quality raw material, but not all of the remaining blast furnaces were engaged in this line of business. Messrs. T. and I. Bradley, at Darlaston,

even began the production of some hematite pig iron in 1908, the first to be produced in the district; for this purpose high-class Spanish ore was imported.(19) One notable failure in the period was that of Messrs. W. Barrow and Sons, of the Bloomfield Ironworks, Tipton, most famous, indeed, for the celebrated BBH brand. It has been suggested that the actual works were dismantled in 1904 but, in fact, they were purchased by Messrs. Benjamin Bunch and Sons of Walsall in April 1904 (reported purchase price a little over £20,000); the new owners kept the blast and puddling furnaces going until their own failure five years later.(20)

1905 was a satisfactory year for the pig iron department; all metal produced was soon purchased. It was noticed that the Midland counties, and especially Shropshire, Derbyshire and Staffordshire, fared better than other pig iron producing areas; the difficulty remained, however, that whilst the smelters were unable to meet all the requirements of local consumers there was still not the confidence amongst furnace proprietors generally to encourage large expansion programmes. To have appreciably increased the district's output would have taken time and would have necessitated the expenditure of a large amount of capital. Early in 1906, the situation deteriorated again; weakness was first felt in the warrant markets of Scotland and the north of England. Stocks began to

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(19) Colliery Guardian, 24/7/08.

(20) Colliery Guardian, 8/4/04 and 14/5/09. The failure of Benjamin Bunch in 1909 caused a sensation in the district. When a meeting of creditors met in May it was declared that the firm had liabilities to unsecured creditors of £10,000 and a liability to the bank for a further £17,000. It was further estimated that if the firm was sold as a going concern it would produce a surplus of £5,000; if there was a forced realisation it could mean a deficiency of £5,000. A committee of three was, in fact, set up to try to keep the works going, but in 1911 it had obviously failed. The works was then bought by Thomas Smith and Sons, Ltd., of Saltley Mill, Birmingham, but not for smelting or marked bar purposes.

build up and Hickman's Spring Vale works was reported to have 20,000 tons of pig iron on hand. Messrs. Whitehouse's Priorfield works decided, instead, to restrict make by blowing out a furnace. The latter firm argued that if merchants knew that there were large stocks of pig iron throughout the district, they would simply try to force prices down still further. Fortunately for the smelters, the dullness in the trade did not last much beyond the summer period and, with Northants pig being exported to Germany and Belgium rather than sent into the Black Country, something of a 'boom' in pig iron took place. Conditions proved so promising in the early months of 1907 that at one or two places, such as Darlaston, entirely new blast furnaces were being erected.(21) Reports were even circulated in the district that "one well-known local firm of pig iron makers have been drawing at least £2,000 per week profit".(22) However, the high prices of pig iron clearly handicapped the finished iron trade and, in one sense, this was a factor which undermined the continued prosperity from the point of view of the smelters. By the late spring of 1908, a definite downward trend had set in and a number of blast furnaces blown out; this situation lasted for something like nine months before a renewed burst of activity took place. Messrs. Wm. Roberts Ltd., of Tipton, made a profit of only £6,834 in the year ending April 1907, but in the following twelve months profits reached nearly £20,000. Whereas ordinary shareholders had received a 10 per cent dividend in 1907, in 1908 they received 20 per cent, including a bonus of 10 per cent.(23)

It came as something of a shock to the district when, in April 1911, a creditors' meeting of H.B. Whitehouse and Son, Ltd. was held. The

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(21) Colliery Guardian, 31/5/07.

(22) Colliery Guardian, 22/2/07.

(23) Colliery Guardian, 28/5/09.

firm had a very good reputation for a high-class Staffordshire foundry pig and until very recently had been blowing two out of three furnaces at their works in Bilston. Liabilities totalled £13,000 and, although if kept as a going concern assets were thought to total around £16,000, the situation proved to be beyond recovery.(24) The departure of another pig iron producer, coupled with the fact that the Spring Vale works had not been selling pig on the open market since August 1910, enabled some of the remaining smelters to enjoy satisfactory conditions. Early in 1912, the Darlaston Blast Furnaces, the Tipton Green Blast furnaces, the Wednesbury Oak Ironworks and the firm of Messrs. M. & W. Grazebrook of Dudley were all reported to be doing well. Conditions somewhat worsened late in 1913 and 1914, and something like six furnaces were blown out, mainly because of the slackness in the finished branches of the iron trade.

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(24) Colliery Guardian, 7/4/11. H.B. Whitehouse & Son, Ltd., clearly fitted the following description: "... most of the pig- or finished-iron makers owned nothing but their own plant, and brought all their raw materials in the open market". (Handbook for Birmingham & Neighbourhood, British Association Meeting, 1913, p. 13.

### Wrought Iron Producers.

By the middle of the nineteenth century, the Black Country was firmly established as one of the leading centres of wrought iron production in the United Kingdom. Some 100 independent firms existed in the district, many of which were small in size. Puddling was not a capital- but rather a labour-intensive process, and much depended upon the skill of the puddlers themselves. Over the years, the district had acquired a reserve of highly-skilled labour for the production of wrought iron, and these two factors had encouraged the growth of small units of production. In 1852, there was a small number of firms with as few as six puddling furnaces, although the average size was probably somewhere between 20 and 30 furnaces. The Bloomfield Ironworks of Barrows and Hall was the largest single wrought iron unit in the district with 46 furnaces; in addition, Barrows and Hall had a further 25 furnaces at their two other works. Other important producers in 1853 included Th. Davies and Company of Cookhay, West Bromwich, with 38 furnaces, and George Jones of Spring Vale and W. Williams of the Albion Works, West Bromwich, both with 32 furnaces each. By 1860, the New British Iron Company was very much up with the leading producers, with 62 puddling furnaces, whilst the Earl of Dudley had 45 furnaces at Round Oak, and a smaller number at Coneygre. Many of these larger firms continued to grow over the next ten years or so, although some did fall by the wayside or exchanged ownership. In 1872-3, when, numerically, the Black Country reached its peak<sup>(25)</sup> with regard to puddling furnaces, the following were the leading works:

William Barrows & Sons of Tipton ...	100	puddling furnaces
Patent Shaft & Axletree Company .....	86	" "
G.B. Thorneycroft, Wolverhampton ...	74	" "

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(25) The next most important district about this time was the north-east; in 1869, there were 1300 puddling furnaces in the district, some of which were owned by concerns larger than those to be found in the Black Country.

J. Jones had recorded the existence of over 100 works in the boom of 1871-73, with a total number of 2,115 puddling furnaces.(26)

The larger works, with the notable exception of William Barrows and Sons, were all integrated back to smelting and some right back to the raw materials for the blast furnaces. The Tipton firm was probably the most famous manufacturer of wrought iron in the country, and yet it purchased nearly all of its pig iron requirements from the Earl of Dudley or the Lilleshall company in Shropshire. Over 1000 workers were, nevertheless, employed by the firm. The New British Iron Company had six blast furnaces, at Cradley Heath, and others at Dudley Wood, together with coal mines and fireclay mines at Stourbridge, and 71 acres of land leased around Wolverhampton. The Earl of Dudley, in addition to his blast furnaces, had limestone quarries, iron and coal mines as well as a large finishing department at Round Oak. All told, in the early 1870's, he employed nearly 5,000 persons. Patent Shaft, which bought up Lloyds, Fosters and Company in 1867, itself an integrated firm, possessed blast furnaces at Willenhall and elsewhere, but it was a large purchaser of pig iron and remained so even in its days as a steelworks. In 1873, nearly 4,000 persons were on the company's pay-roll. G.B. Thorneycroft, the leading ironmaster in Wolverhampton in the 1860's and 70's, was a rare example amongst Black Country wrought iron producers of displaying the characteristics of horizontal integration as well as being a vertically integrated firm. G.B. Thorneycroft owned both the Shrubbery and the Swan Garden Ironworks, where some 1000 people were employed at this time.

Long before the industry reached its peak it had been showing signs of stagnation. In the 1840's, accusations had been levelled at the industry that its productivity rate was not equal to that of South Wales. There, the puddling furnace was worked for about 140 hours per week and produced, on average, about 18 tons per furnace. The Black

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(26) Ed. S. Timmins, op cit, p. 69.



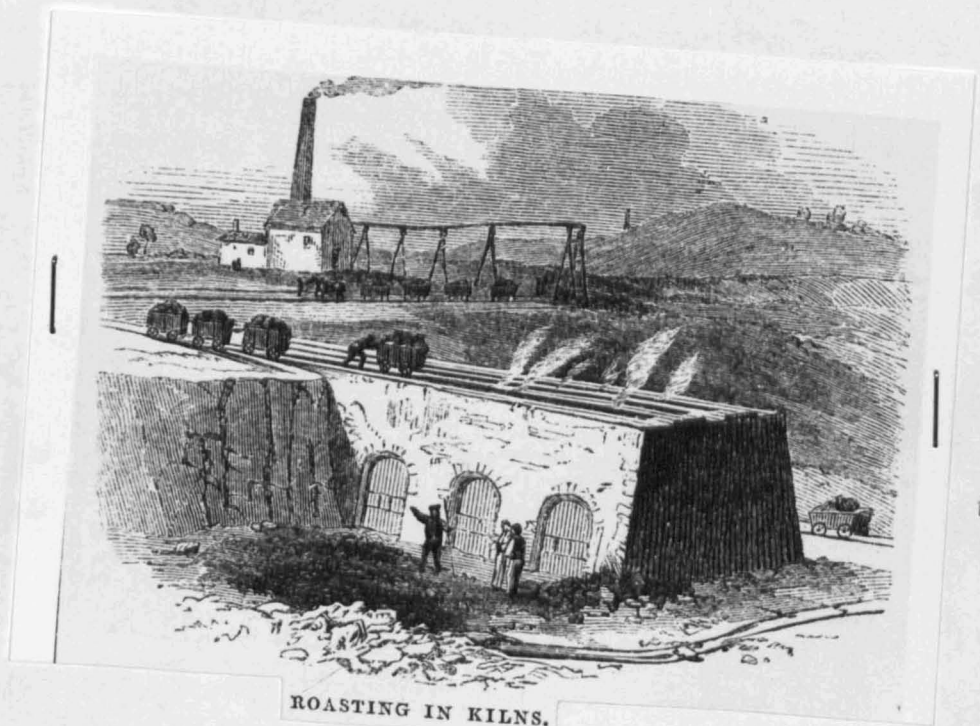


Fig. 3.

ROASTING IN KILNS.

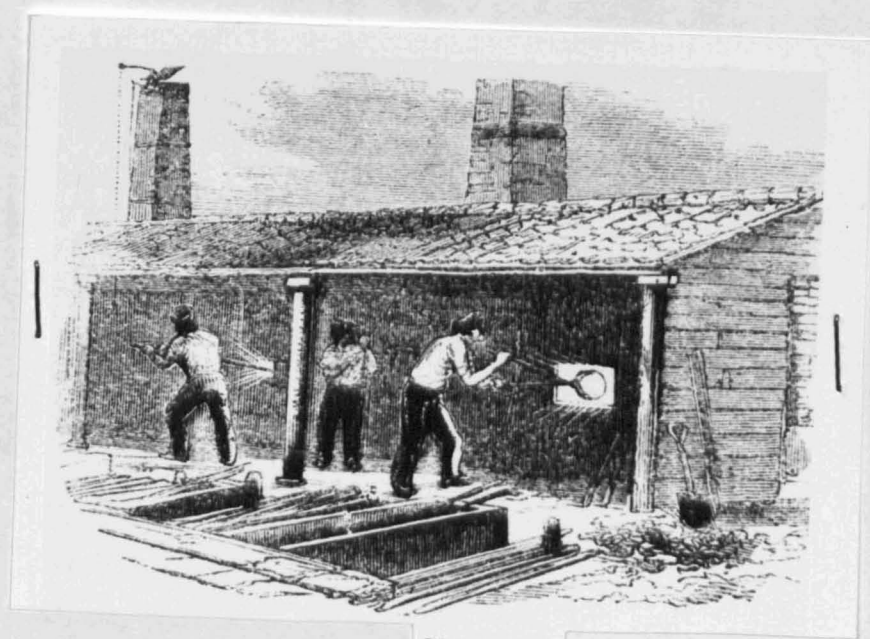


Fig. 4.

PUDDLING.

Country furnace was worked for something like 100 hours per week, and produced 10 tons of iron. This figure does not seem to have been improved upon by the mid-sixties, because Jones estimated then that the 2,115 furnaces in operation had a potential output of 20,000 tons of iron per week. The weekly make in the north-east was 12 tons per furnace; in the Sheffield area the puddling furnaces at John Brown's Atlas Works, numbering twelve, produced on average a weekly make of 100 tons in the early 1860's.(27) Where the Black Country scored over all its rival districts was in quality.

All the proprietors of puddling furnaces were engaged in the production of bar iron and this section of the Black Country iron trade is covered under the present heading. What happened to the bloom after leaving the puddling furnace very largely determined the quality of bar produced and it was upon the process of re-working the bloom that a good deal of South Staffordshire's high reputation rested. It has frequently been remarked that an interesting feature of wrought iron is that "its physical properties, particularly its tensile strength, can be improved by doing mechanical work on it".(28) By careful selection of pig irons, together with a series of re-rollings (including a system of re-heating in a small mill furnace), various qualities of bar iron could be produced from the puddled blooms. To produce a puddled bar or muck bar the bloom was simply passed through the forge train or primary rolling mill. Very few firms actually sold muck bar and certainly it was never listed by the more reputable firms. Crown or merchant iron was, in fact, the lowest grade bar iron for general sale and was the result of the muck bar being re-heated in a mill furnace and then re-rolled once. A re-working of crown iron produced the next grade Best

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(27) Sir Allan Grant, Steel and Ships, 1950, p. 16.

(28) W.K.V. Gale, The British Iron and Steel Industry, 1967, p. 77.

iron, and so on to produce Best Best (BB iron) and, finally, Best Best Best (BBB iron). Very few firms, again, produced BB or BBB bar iron, and those who did came from a number of firms termed list or marked bar houses. The number of Marked Bar houses was, obviously, limited and throughout the period under discussion that number was declining. The BBH brand of the Tipton firm was particularly famous as, so too, was the Earl of Dudley's LWRO and "HURST" brands. The five longest surviving Marked Bar houses were the following:

<u>Brand</u>	<u>List House</u>
"Lion" brand of Netherton Ironworks	N. Hingley & Son Ltd
"L Crown WRO"	Round Oak Iron & Steel Works
"Crown HB"	
"Crown BBH"	Bloomfield Ironworks
"Crown JB Bagnall"	Lea Brook Ironworks, Wednesbury
"J Bradley & Co" and "Crown SC"	Stourbridge Ironworks

An important feature of the Marked Bar houses was that, as near as possible, they marketed their goods on a united front. Generally speaking marked bars fetched upwards of £1 per ton more than the other bars (Round Oak did produce unmarked bars as well from the second half of the 1890's). Between 1890 and 1895, marked bars gradually declined in price until they had reached £7 per ton; to some extent this reflected the gradual take-over of steel. However, at the end of 1896 an improvement began and by April 1898 marked bars had recovered to £8/10; by February 1900, prices had soared to £11/10, the highest recorded price since 1875. Over the next ten years or so, there were falls in the price level but the average price was about £8/10 to £9 which, considering the very severe foreign competition in the common bar trade, is a tribute to the high quality of the South Staffordshire product. It was described in 1905 "as a beautiful fibrous iron which is in great demand".(29)

The majority of firms with puddling furnaces and rolling mills in the

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(29) Colliery Guardian, 3/11/05.

Black Country concentrated on the production of common bar iron (crown or merchant iron). Because there were so many firms engaged in the manufacture of bar iron there was intense competition. Again, too, it was a section of the Black Country iron trade which had to face the heaviest competition from outside sources. In the period up to the 1890's, competition to the Black Country producers came largely from South Wales, the north-east and Scotland. South Yorkshire provided some stiff competition in the higher quality bar trade. Continental competition predominated in the period after 1900, especially from the Belgians. To try and preserve as much of the trade as possible, a number of Black Country producers set up the Unmarked Bar Makers' Association (discussed in detail elsewhere). Only in periods of good trading conditions, however, did the Association succeed and, overall, its influence on preserving the industry in the district was probably only slight. In one other area, too, did this section of the iron trade show initiative, and this was with regard to ironworkers' wages. Although not without its ups and downs, the Wages Board was a serious attempt by management and labour to deal with the difficult issue of the puddler's wages; very simply, individual firms were affiliated to the Wages Board, the prices which they obtained for their products (wrought iron) were checked by accountants bi-monthly and the ironworkers' wages were then regulated on a sliding-scale. Apart from many obvious shortcomings, the main weakness of the system was the fact that less than half the number of firms in the district were affiliated. In 1910, for example, out of 40 or 50 firms engaged in the bar trade, only 17 were members.(30)

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(30) Colliery Guardian, 26/2/04.

Apart from the very brief periods when the downward trend was arrested, the wrought iron section of the Black Country iron trade was declining throughout the last quarter of the nineteenth century. The reason for this was simple; one by one the main finishing departments went over to steel and, in the case of the Black Country, imported steel 'semis' became the life-blood of the re-rolling mills. Despite its decline, however, the manufacture of bar iron remained the chief output of the district's iron trade; for example, in May and June 1904, of the 26,000 tons of manufactured iron produced in the district, 19,000 tons were of bar iron. Then, again, as late as 1910 out of the total output of a little over 200,000 tons of manufactured iron made by the 17 firms affiliated to the Iron Trade Wages Board, 131,000 tons were made up of bar iron.(31) Of the 2000 or so puddling furnaces which had existed in the late 60's and 70's, less than 1200 remained in 1895. By 1913, that total had been almost halved again, and only 660 furnaces were still in operation.(32)

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(31) Colliery Guardian , 19/5/10. Except on rare occasions of heavy demand, something like 15 per cent of the puddling furnaces were idle.

(32) British Association Handbook for Birmingham, 1913, p. 417.

### Steelworks.

Apart from the Old Park Works of Lloyds, Fosters and Company, Bessemer's discovery of making steel in the converter found little sympathetic support in the Black Country. A number of points can be made at this stage. There was no particular reason why Bessemer steel should not be made in the area, as the Lloyds showed when their plant came into full operation in 1864, provided the area's ironmasters had been prepared to experiment and innovate. The local ores were not satisfactory, but for some time very few local firms had been making pig iron without ores imported into the district from a wide field, including the very suitable ores from the Cumberland region. Furthermore, Bessemer steel did not materialise as a major threat to the local wrought iron department until the eighties. The iron-rail trade was the first section of the industry to feel the cold blast of competition from this direction, and the South Staffordshire area had only momentarily remained concerned with the production of rails. Steel sheet began to rival the wrought iron product only in the eighties, although it is interesting to note in passing that the first steel sheet was produced by the Bilston firm of Hatton & Company in 1876 from a steel slab made at Panteg Steelworks, Monmouthshire. Cost, and the possible heavy investment in puddling furnaces, mattered only marginally more so in the case of the Black Country than in other areas; besides, it is doubtful if there had been much new investment in puddling furnaces in the decade or so immediately before Bessemer's discovery. Over 20 per cent of furnaces existing in 1872 had been built within the previous three-year period, and a great deal of investment went into the older technique even after this date. Besides, although within a year of the Cheltenham speech the Birmingham-Wolverhampton area was hit by a sustained financial crisis, it would not be correct to take the view that the larger producers in the area were prevented from installing converters because of a lack of capital. Why,

then, did not more Black Country ironmasters follow the lead taken by Samuel Lloyd? In the short term, the answer could lie within the very slow growth in the demand for steel. Before embarking on the new venture, the Old Park Works had carried out a little primitive market research; nevertheless, their four 3-ton converters could not be operated at full capacity for some time because of insufficient demand. In the long term view, however, there are two very important factors to be considered. For that school of thought which holds the view that physical factors determine the location and subsequent growth of a particular industry it can be stressed that Bessemer's process, by lessening the amount of fuel required, reduced the advantage of a coalfield location for the finishing trades. The Black Country iron trade was, after all, essentially a coal-based industry. For those who hold that the personal factor predominates, the over-riding reason for the lack of interest displayed was the conservatism both of the Black Country ironmaster and of the available work force. One of Bessemer's main opponents and critics was Joseph Hall (1789 - 1862), born in Tipton and the man who perhaps made the most valuable contribution to the working of the puddling furnace in the nineteenth century. Hall very largely misunderstood the nature of Bessemer steel, but found that his views were readily accepted by the majority of his fellow ironmasters in the Black Country. After all, in its day the firm of Barrows and Hall at the Bloomfield Ironworks, Tipton, with its renowned BBH brand of bar iron, was one of the leading centres of iron manufacture in the world. Added to the known and often commented-upon reluctance to accept change on the part of the South Staffordshire puddler was the very relevant fear of the puddler that Bessemer's process was aimed at cutting down on the labour force in general and reducing the need for a skilled force in particular. In his Cheltenham speech, Bessemer did stress that his process required "no

other fuel than is contained in the crude iron" and "no manipulation or particular skill, and with only one workman".(33) Unless carefully supervised (and how much of the South Staffordshire management of the 1860's and 70's was capable of this function?), a possibly hostile labour force, used to dealing with iron in any case, could easily spoil Bessemer steel and yet put the blame on the defective process. For his own part, Bessemer found obvious satisfaction in proving the superiority of his metal over "best Staffordshire iron plate"(34) for the making of cylinders. He had carried out tests to this effect with Ebenezer Parkes of the Birmingham Corrugated Iron Company, but there is no evidence to suggest that in general Black Country users of Staffordshire iron plate were prepared to accept the superiority of Bessemer steel in the manufacture of cylinders or boiler tubes. Again, there were few prepared to follow the lead taken by "a Mr. Thompson of Bilston" who chose Bessemer mild steel in 1862 in the making of barrels for the Enfield rifle.(35)

Despite the fact that Siemens' "Sample Steel Works" was set up in Birmingham in 1866, no Black Country iron firm showed sufficient faith in the open-hearth process to lay down the necessary plant until much later in the century. This was also the case with both the Sheffield area and the north-east. Undoubtedly, a relevant factor in this period which kept the more conservative and, possibly, patriotic, ironmaster from using the open-hearth process was the fact that the French firm of P. and E. Martin at Sereuil was the first successfully to produce open-hearth steel. Earlier experiments at Ebbw Vale, Barrow, Sheffield

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(33) Sir Henry Bessemer, An Autobiography, 1905, p. 159 .

(34) The Engineer, May 1862.

(35) Sir Henry Bessemer, op cit, p. 204.



and Towlaw had all failed. Whilst the acid open-hearth process still failed to deal with the phosphorus problem, the fact that both scrap-iron and cheap low-grade coal could be used should have made it an attractive proposition for the South Staffordshire area.

One of the brands of pig iron made in South Staffordshire was known as "Common Cinder"; Hickman's Numbers 1 and 3 blast furnaces were given over to the production of this type of pig in 1880, which was the cheapest in the district and was made largely for customers who were engaged in the manufacture of tubes for the gas industry. The "tap cinder" used in the blast furnace was the slag (often termed the refuse) of the puddling furnace, and had been in use since John Gibbons had first shown the way in the 1830's. South Wales and the Forest of Dean were two other areas where the cinder had been used, but because of the large size of the local wrought iron industry Black Country supplies of the product were abundant. Many Black Country ironmasters had continued to view its use with suspicion, despite the fact that it contained 45 per cent of iron, which amounted to a higher metallic content than many of the local and 'imported' ores, and could be obtained in 1880 for the cost of carriage or 3d. per ton. Sidney Gilchrist Thomas quickly recognised the value of tap cinder for his basic process - the pig iron produced from it was "high in manganese and phosphorus and low in sulphur" (36) - as did the German steelworks. He was deeply disappointed to hear that Lowthian Bell was actually shipping large quantities of cinder from the Tees to the Continent. Fortunately, one of the newer ironmasters in the Black Country, Alfred Hickman, showed a little more initiative; Hickman realised that although the Black Country had no special attraction for the production of acid steel basic steel was a much different proposition. Hitherto, Hickman's experience had been with blast and puddling

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(36) Paper read before the Chemical and Physics Section of the Society of Arts, April 27, 1882. Thomas referred specifically to Staffordshire cinder pig as being "a very good example of basic Bessemer pig iron".

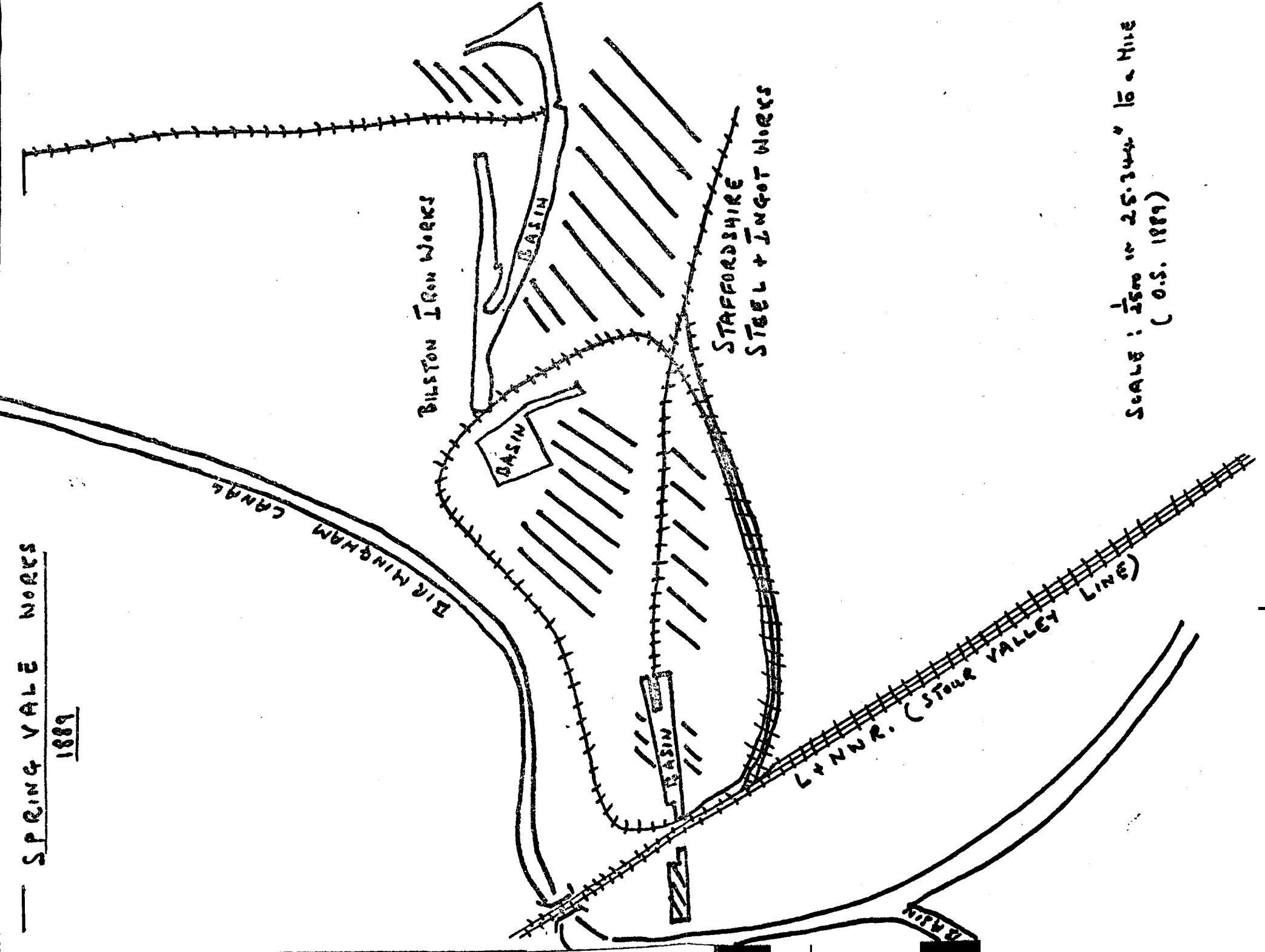
furnaces - his father had possessed 28 puddling furnaces at Groveland and Stonefield - so he was in a position to gauge the practical advantages of the one process over the other. Accordingly, at his expense and under his own direction, Hickman arranged for a trial of the basic process to be carried out using the local cinder pig.<sup>(37)</sup> The Patent Shaft and Axletree Company, owners now of the first acid converters in use in the Black Country at the Old Park Works, allowed Hickman use of their disused pit at the Monway Works. Both Thomas and Gilchrist were present to supervise operations when between 70 and 80 tons of pig iron "were blown in a pit which had been out of use for some years, and lacked all the special appliances for the efficient working of the de-phosphorisation process". The results were good and confirmed the many excellent performances which the basic process was then giving in Germany and Austria. It was the view of both Thomas and Hickman that cinder pig would give a steel that was "well adapted for the manufacture of tin plates, sheet, wire, tubes, plates, &c., as well as for rails, axles, tyres, &c.." Accordingly, Hickman went ahead with his plans for the erection of plant for making steel alongside his blast furnaces at Spring Vale, Bilston. No praise can be too high for Hickman because it must be remembered that outside of Scotland very few members of the United Kingdom industry were prepared to take this step. A subsidiary company was formed for the purpose, the Staffordshire Steel and Ingot Iron Company, Ltd.; three of the four converters formerly owned by the Mersey Steel and Iron Company of Liverpool, which had gone into liquidation in 1881, were purchased<sup>u</sup> by Hickman. Rolling mill equipment was also put down. To finance much of this move, Hickman was forced to sell off some recently acquired land. Some rationalisation of his works had been necessary. In October 1881, he had purchased the Cappon Field

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(37) J.I.S.I., 1882, pp. 195-97.

— SPRING VALE WORKS

1889



SCALE:  $\frac{1}{2500}$  or 25.344" 15.4 Mile  
(O.S. 1889)

Furnaces and Colliery from Richard Bagnall for the sum of £9,500.(38) However, in 1885 he decided to sell off Bagnall's old furnace plant to T. and I. Foster for the sum of £10,000, and with this money he was able in part to finance his venture into steel production.(39)

Hickman continued to display outstanding qualities of leadership in a new industry when, a little later in the decade, he experimented with the use of different basic open-hearth furnaces. The Directors of Patent Shaft had watched Hickman's progress with interest and they, too, took the decision to go over to the production of basic steel. Some £20,000 were spent on "steelmaking plant suited to modern requirements", but it is clear that the move did not go without difficulty because in 1892/3 the same Directors had to announce a loss of £10,265 and that no dividend was possible on either class of shares.(40) The Earl of Dudley's Round Oak Works had also taken the decision to become a steelmaking plant; perhaps because of Hickman's experience, Round Oak put down open-hearth plant. According to R. Smith-Casson(41), by the end of 1890 one Siemens-Martin furnace was in operation with a production capacity of 3,000 tons per year. He thought it of interest to tell the South Staffordshire Institute that "only slack was burnt in the works", which thus made the whole process extremely economical as far as fuel was concerned. It was extremely unfortunate that just when the steelmaking process was beginning at Round Oak the Earl of Dudley should have sold the works for £110,000.

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(38) Property Deeds in the possession of the British Steel Corporation.  
(See also Map 4, p.31a)

(39) Documents in the hands of Bradley & Foster Ltd..

(40) Colliery Guardian, 24/2/93.

(41) Proc. S. Staffs., 1890-91, pp. 22-26. G.A. Millward (Patent Shaft) expressed concern that the appearance of a third steelmaking firm in the Black Country might lead to "competition which would lead to losses rather than profits". Ibid, p. 27.

The new company, the Earl of Dudley's Round Oak Works Limited, continued with the steelmaking venture and, in fact, some £40,000 to £50,000 were spent on plant extensions. However, serious financial weaknesses brought the company into difficulty; a loss of £18,000 was made in the financial year 1891 - 92(42) and, after further losses in 1893, it went into voluntary liquidation in December 1893. The Earl of Dudley once more found himself with an iron and steel works; progress in the steel department had continued and in August 1894 reports were given in the trade journals of steel production at Round Oak. By October, Round Oak had already commenced cogging and rolling down ingots and they were ready to place upon the market "mild steel in the shape of bars, angles, tees and other sections suitable for light engineering work".(43)

Although previous writers have tended to skip over developments in the Black Country steel industry, and to suggest that very little of interest took place, the three large steel producers in the district were extremely active and successful from 1894 onwards. By 1894, in fact, the consumption of steel in the Black Country had grown considerably, with a steady, and sometimes heavy, demand for steel for the making of boilers, gasometers, bridges, stamping and roofing sheets, etc.. Having greatly extended their plant in recent years, Scotch and north of England steel firms had tended to dominate the Black Country market. Siemens steel plates for tube-making purposes were offered by these northern steelmakers at "about £2 a ton below Staffordshire plates produced by the list houses"(44), whilst steel strip was offered delivered at 5/- per ton below local prices(45). Nevertheless, Hickman's works were said to be "among those firms who keep busy in supplying large sections of constructive steel"(46) All three Black Country steelworks benefited from

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(42) ICTR, 16/9/92.

(43) Colliery Guardian, 12/10/94.

(44) Colliery Guardian, 2/3/94.

(45) Colliery Guardian, 15/6/94.

(46) Colliery Guardian, 8/6/94.

domestic railway development in 1894 - 95; Patent Shaft and Round Oak were busily engaged in extensive contracts in connection with the Manchester, Sheffield and Lincolnshire Railway extension, whilst Hickman was said to have an order for 6,000 tons of steel plates arising out of the new line from Sheffield to London.(47) Open market quotations for basic material in 1894 were as follows:

Bridge plates	.....	£5/10	per ton
boiler "	.....	£6/5	" "
ordinary bars	.....	£5/5 - £5/10	per ton
round bars	.....	£6	per ton

Despite the fact that Hickman had taken pains to point out in 1881 that the basic steel produced was suitable for rolling into sheets, neither he nor the other two steel makers supplied the local re-rolling sections with blooms and billets from which to manufacture sheets and bars. Before it got into financial difficulties, the Chillington Iron Company in 1881 had considered the possibility of sponsoring a venture into the manufacture of steel 'semis' for the district's finishing trades. The idea was raised again and again over the next twenty years but, as is shown elsewhere in this script, no new steelworks ever materialised. However, in the discussions which took place on this subject in the 1890's a number of points were made which go some way towards explaining why the Black Country was, indeed, a very suitable district for the manufacture of steel. In 1898, and again in 1902, when Le Neve Foster, president of the South Staffordshire Institute of Works' Managers, took an interest in the idea of a new steelworks, the Black Country had become almost mesmerised by all things American. He stressed that given sufficient capital to build a works of "large producing capacities", South Staffordshire could match the actual price of £3 per ton for hematite steel in America"(48). Le Neve Foster was naturally not suggesting that

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(47) Colliery Guardian, 5/10/94.

(48) Proc. S. Staffs., 1898-99, pp. 39 - 40 and 1901-02, p. 101.

the district should try to produce acid steel; he was pointing out that South Staffordshire had an advantage over the American industry in that they could sell a by-product from the production of basic steel, i.e. basic slag as a fertiliser at between 35/- and 30/- per ton. Hickman, in fact, sold something like 300 tons of basic slag a week, much of it being exported to Germany.(49) Other advantages possessed by the Black Country for the production of basic steel were listed by Le Neve Foster: "... cheaply raised ore deposits in Northants and Oxfordshire in addition to the tap cinder of the ... ironworks ... large limestone deposits ... together with Stourbridge fire-brick ..." Although the bulk of the coke used by the iron trade had to be imported from outside the district, there were good rail links with South Yorkshire, Durham and North and South Wales. For small production figures, Le Neve Foster advocated the installation of open-hearth plant; the Bessemer method was essential for works of 1500 to 2000 tons per week upwards.

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(49) Le Neve Foster was only too aware of Hickman's need to export his basic slag to Germany. As yet, the British farmer had not realised the value of the material, although one expert (probably G. Redgrave in the Journal of the Society of Arts, xxxviii, pp. 221-234) had pointed out that "every ton of basic slag exported out of the country at £2 per ton is a loss of £5 per ton to the community at large". The Germans were only too willing to purchase British phosphates; they used over 300,000 tons of basic slag annually by 1889, and a third of that came from England and Austria. (C.M. Aikman, Basic Slag as Manure, pamphlet published by National British Agriculturist, 1889). Le Neve Foster further stated: "Some ironmasters had been faced with the prospect, which had been raised 15 or 16 years ago and then ridiculed, that, taking the cost of production into consideration, steel will be the by-product and phosphorus the main object". It was certainly true in the 1930's that S. & L. made a bigger profit (through their contracts with Tarmac, Ltd.) out of their slag as a road-making material than out of steel production.

Although this could be thought of as an optimistic view of the situation in South Staffordshire, it was one shared by a number of those actually engaged in setting up steelmaking plant in the district. F.W. Harbord stated in January 1891:

"... in this district we are very favourably situated for making basic pig. We have large accumulations of cinder which can be got cheaper than in any other district, and we have the means of getting Northamptonshire ore very readily and cheaply, and this ore is exceedingly free from sulphur, which is a most vital point in the making of basic pig. Then we have coal free from sulphur and low in ash; and given a pure ore and fuel, we have the two essentials for the manufacture of basic pig".(50)

Purcell, the manager of the steel department at Round Oak, also shared this view. He saw no reason why South Staffordshire "should not be as pre-eminent for the manufacture of basic material as it has been for iron".(51) Purcell just as strongly agreed with Smith-Casson and Le Neve Foster that many of the stated advantages would be wasted unless "the thing is taken up with energy and enterprise". "If we are to make steel economically", said Le Neve Foster, "it must be made by large installations and mechanical labour-saving appliances, coming with ore raising and not finishing until the steel leaves the works". J.S. Jeans, on a number of occasions, argued that lower production costs, together with greater productivity, could only be brought about through capital expenditure.(52) He was well aware that the existing structural weaknesses of the Black Country industry would prevent the adoption of American methods unless some radical line was taken. He therefore suggested

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(50) Proc. S. Staffs., 1890-91, p. 28.

(51) Ibid, p. 29.

(52) Proc. S. Staffs., 1902-3, p. 44.



that the South Staffordshire Institute would be well rewarded if it "were to appoint a Commission to consider what would be the effect on the local iron industry of merging the many small concerns now carried on in the district into a smaller number of larger ones ... The average capitalization of the works of Staffordshire unquestionably falls much below the United States figure of £200,000." The Institute did not take up the idea of a commission, although Jeans did have supporters in the district. James Roberts, for example, echoed the latter's words when he spoke of a lull in the danger arising from American competition which the area must take full advantage of:

"We have now before us ... a period of two or three years in which we shall have comparatively little competition from America. In these two or three years we shall have to put our house in order and get ready for re-newed competition. We must spend money like the Americans do, and we can only do that by effecting combinations such as will give us control of large amounts of capital".(53)

Meanwhile, the three steel producers in the district were experiencing satisfactory trading conditions. Frequently in these years, competition from the north of England and Scotland almost ceased completely; whilst Round Oak and Patent Shaft were said to be managing well, the Staffordshire Steel and Ingot Iron Company's turn-over was reported to be larger "than it has ever been since the works were built".(54) An increasing demand for open-hearth steel was, in fact, the main reason for the decision of the Earl of Dudley to go public in 1897. Alexander Smith, consulting engineer and valuer of Birmingham, carried out a valuation of the Round Oak Works in May and June 1897. On "a current going concern basis", Smith valued the concern at £174,061/5/11.(55) In July of the

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(53) Proc. S. Staffs., 1901-02, p. 160.

(54) Colliery Guardian, 28/8/96.

(55) Valuation of Round Oak Ironworks, 30 June 1897, by Alexander Smith, M. Inst. C.E., Birmingham. (Document in Dudley Public Library, copy in my possession).

same year a new company - the Earl of Dudley's Round Oak Works Company, Limited - was registered with a capital of £100,000 in £5 shares; it was to acquire and take over the iron and steel-making business of the former company and "to carry on the business of ironmasters, steelmakers, steel converters, colliery proprietors, coke manufacturers, miners, smelters, engineers, tin-plate makers and ironfounders".(56) According to Alexander Smith's valuation of 20 October 1897, the new company had, in fact, acquired 'stocks, loose plant etc.', together with a goodwill valued at £9,222/15/0, for £65,000. Subscribers to the new company, in addition to the Earl of Dudley, were G.H. Claughton (agent), J. Tryson (solicitor), C.H. Saltwell (solicitor), G. Hatton (manager), E.B. Stead (cashier) and Alexander Smith (engineer).

An indication of the success being experienced by the new steel industry of the Black Country was the fact that in 1897 the £5 shares of the Staffordshire Steel and Ingot Iron Company stood at £18 to £20. At all three works new steel plant was being laid down, a fact that led some observers in 1898 to feel "that the district has a prosperous future before it".(57) Throughout that year and the next, Hickman was able to raise his prices to new levels; instead of having to face competition from the north of England, the district's steelworks found themselves in receipt of orders from that direction. In April 1899, Hickman's quotations were as follows although, in actual fact, he was already fully booked to the end of June:

<u>Product</u>	<u>Price per ton</u> (terms 2½% f.o.t. at makers' works)
plates	£7/15 - £8/5
angles	£6/15 - £7
tees	£7 - £7/5
flats	£6/17/6 - £7
rounds	£7 - £8
channels	£7
girders	£6/15 (58)

By the early years of the present century, a number of people spoke

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(56) Colliery Guardian, 3/7/97.

(57) Colliery Guardian, 24/6/98.

(58) Colliery Guardian, 14/4/99.

with admiration for the efforts of both Sir Alfred Hickman and the Earl of Dudley. The president of the South Staffordshire Institute in 1904-5, H.B. Toy, remarked:

"This district has benefited by the enterprise of Sir Alfred Hickman and the Earl of Dudley to a very great extent, and it is very evident from the enormous amount of money they have recently spent, and are to-day spending, that they attach very great importance to the necessity of keeping abreast of the times, as a means of maintaining our trade".(59)

Certainly, both Round Oak and Spring Vale had reacted to fierce foreign and domestic competition by seeking new production processes in an effort to reduce their costs. In 1907, indeed, the latter works embarked on a fresh programme of expansion; between £50,000 and £100,000 was reportedly spent on new plant to enable Sir Alfred Hickman, Limited to take on the Continental firms in supplying the local re-rollers with small sizes of steel bars. Hitherto, the local sheet manufacturers had not been able to buy their steel requirements locally. Round Oak embarked on a further round of expansion in 1909, but when it was remarked in the trade press that billets could be made in South Staffordshire "at a price which would, if necessary, defy all legitimate competition in the Midlands markets"(60), it was Sir Alfred Hickman who was given the credit for bringing "a new lease of life" to the district's steel industry. Although figures can only be guessed at, the Black Country had for some time been producing around 300,000 tons of steel per year, with twice as much being produced by the open-hearth method as the Bessemer process.(61)

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(59) Proc. S. Staffs., 1901-02, p. 166.

(60) Colliery Guardian, 29/10/09.

(61) The totals for 1904 are given by S. Jeans, The Iron Trade of Great Britain, 1904, p. 38.

Apart from the three major steel producing firms in the Black Country, several others made steel for a brief period, if only on a very limited scale. The New British Iron Company and the Smethwick engineering firm of Tangyes Ltd both worked open-hearth furnaces for a time, whilst Hatton Sons and Company at Bilston, with side-blown converters, made 250 tons ingots a week. (62) In 1911, the Weldless Steel Tube Company was reported to have started laying down a Siemens plant "for making their own blooms". (63)

### The Finishing Trades.

No attempt is made here to cover all the finishing trades in depth; the products made of wrought iron in the Black Country were legion. By tracing the development of one or two works, and by the selection of one or two major finishing departments, some explanation is given of the more important trends which were taking place in the district's iron trade. With the occasional exception - there were no finished ironworks at the Priorfields Furnaces at Coseley for example - all the proprietors of blast furnaces and/or puddling furnaces were engaged in the finishing branches of the iron trade. However, there was a much greater number of firms engaged solely in the operation of rolling mills; in 1862, the earliest date for accurate records being available, there were 219 rolling mills, 289 in 1869 and, in the boom of 1872, 329. Numerically, however, the peak was not reached until 1882, when the number of mills had grown to 353. Gale (64) lists no fewer than 36 different "Typical Rolled Sections" to illustrate the vast range of material which was produced by the Black Country mills in the nineteenth

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(62) .K. Warren, The British Iron and Steel Sheet Industry Since 1840, 1970, p. 53.

(63) Colliery Guardian, 3/11/11.

(64) W.K.V. Gale, The Black Country Iron Industry, 1966, Appendix 13, pp. 158-60.

century. Even then, he is not exhausting the subject. His sections, numbers 1 to 12, were termed merchant iron, that is, "they were all of a type likely to be stocked by an iron merchant for sale to both regular and casual customers".(65) No mill-owner attempted to roll all the different types of material; in fact, there was a pattern of district specialisation throughout the Black Country, a situation which applied equally to the makers of sections, sheets and plates, hoops and strips, and skelps for tube-making. For example, works in the Wolverhampton-Bilston area concentrated on sheet production - a further specialisation was to be found in that firms produced either tinned or galvanised sheets - whilst the Cradley-Heath and Old Hill area had the rollers of bar rod catering for a very large chain and cable industry. The Darlaston and Wednesbury districts could boast of possessing some of the finest producers of nut and bolt iron.

Reference has already been made to the number of Black Country firms which went out of business in the closing decades of the nineteenth century. However, there were two points of special interest: first, the heavy financial losses which occurred when the plant and equipment of firms went up for public auction and, secondly, the frequency with which firms changed hands. Forges and mills belonging to the Darlaston Steel and Iron Company, for example, were sold in the early 1880's for a mere £3,750, a loss of just over £21,000 from their original cost. John Dawes' Bromford Ironworks, valued at something like £120,000 in 1882, was withdrawn from auction in 1887 when the bidding ceased at £11,000, whilst the Tipton properties of the old Gospel Oak Company were sold, £10,000, despite a previous valuation of ten times that amount. Benjamin Bunch and Sons of Walsall, indeed, paid the small sum of £20,000

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(65) Ibid, p. 159.

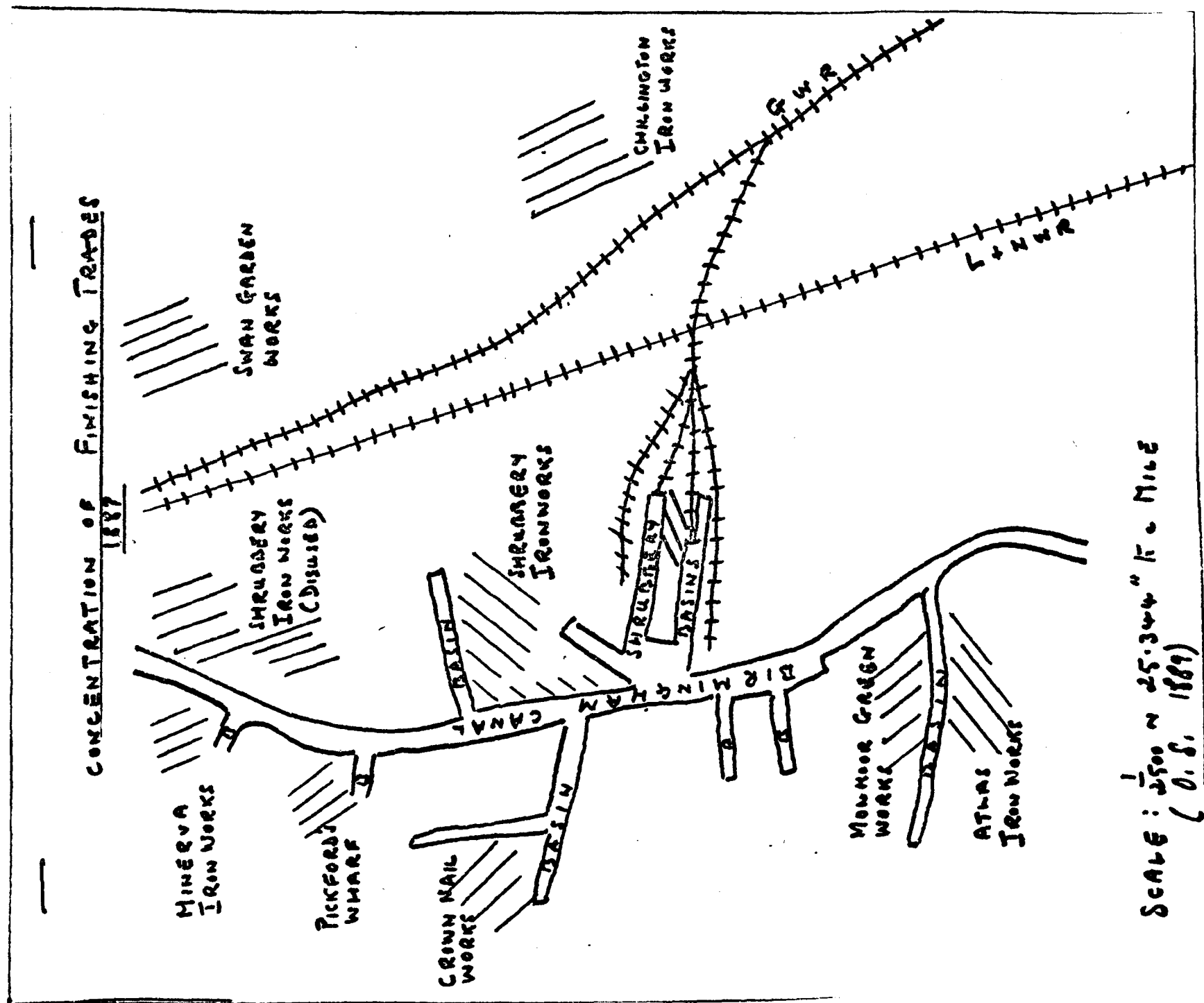
for the Bloomfield Ironworks, Tipton. Each time, too, that a firm went bankrupt the whole district felt the effects: when the misfortunes of Tupper and Company, Limited became clear in March 1911, a number of pig iron and steel producers were amongst the creditors. A local steel-works was owed £5,000, whilst one merchant firm was still awaiting payment for £7,000 worth of foreign steel; an American steel firm was owed a further £15,000.(66) At one time, Tupper and Company, Limited was thought to have liabilities totalling £219,000, but when the dust had settled the figure was nearer £100,000.

Very few completely new ironworks were laid down in the Black Country after 1850; growth in the finishing department of the local iron trade usually took place at the expense of blast furnace and puddling furnace owners, that is, ironworks changed hands and were adapted for different purposes. The trend was definitely away from the production of the raw material (pig iron) towards the finishing sections. The change from one owner to another was also a trend which had been well established by 1850, especially in those sections of the finishing department where large amounts of capital were not necessary for an individual wishing to make a start. The Ettingsall Works (puddling furnaces and sheet mills) were owned by Morewood and Company until 1876; they were then run by the Barbor's Field Company (Davies Brothers) until 1899 before passing into the hands of G. Summers of Coseley who ran them for some years after that date. Similarly with the Capponfield Works of John Bagnall: they were acquired by Alfred Hickman who kept them for a short time, before he, too, sold them (not the complete works) to T. and I. Foster in 1885.

The existence of so many small units of production throughout the Black Country, and their frequent change of ownership, enabled some

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(66) Colliery Guardian, 31/3/11.



SCALE:  $\frac{1}{2500}$  = 25.344" K. Mile  
(O.S. 1889)

firms to grow by the acquisition of other sites; for example, Tupper and Company, Limited had originally started from Berkeley Street and Limehouse, Birmingham, but by the time it collapsed the firm controlled five large works in the Black Country - Batman's Hill Works, Bradley, Pyramid Works, Regent Works, Britannia Works and the Albion Works of West Bromwich.(67) There was some logic in the way the various works had been purchased - Batman's Hill Works were brought for their galvanised sheet mills and the Albion Ironworks for their black sheet mills - but it meant that the various concerns of Tupper and Company, Limited were scattered over a wide area of the Black Country. The Albion Works, for example, were located five miles by canal from the works at Bradley, and  $5\frac{1}{2}$  miles from the Berkeley Street Works.(68) Because of the inadequacies of the canal and railway systems in the Black Country for local traffic, not least the heavy cost, firms like Tupper and Company, Limited unnecessarily penalised themselves by growing in size in this way. The firm would have been better advised to have purchased and then fully developed on an integrated basis, an entirely new site. Few Continental or American firms, with assets (book value) in excess of £216,000 and an annual turn-over of over £1,000,000, would have remained in such a fragmented state as Tupper and Company, Limited.

The management of Tupper and Company, Limited was also at fault in depending for too long on the production of iron sheets when steel sheet production was obviously more profitable. Clearly, in the period from 1880 onwards, one of the most important decisions facing any finishing

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(67) Colliery Guardian, 31/3/11.

(68) This point is pursued in some depth with regard to the local sheet industry by K. Warren, op cit, pp. 45 et seq. The concentration of so many firms engaged in the finishing trades of the Black Country (see Map 5) may have hindered firms from beginning anew on a fresh site.



works in the Black Country iron trade was the point at which the change-over from wrought iron to steel was made. Fortunately for the re-rollers, steel could be used in mills designed to roll wrought iron of comparable size, and some of the old wrought iron makers were not slow to take advantage of this fact. A large trade in small bars and sections was rapidly built up, and the Bilston firm of Hatton and Son had, indeed, shown as early as 1876 that steel could be used in the sheet mills. In the early 1880's, too, steel became the chief raw material in tin-plate manufacture. Technically, there was no reason why steel should not be used for the great majority of goods previously manufactured from wrought iron; where this was not the case, for example, where special corrosion-resisting properties were essential or where welding by hand was practised, wrought iron remained in use. Indeed, the hand-made chain industry "remained a good customer of wrought iron until quite recent times and this was the metal's last real stronghold".(69)

The growth of the Black Country as a market for steel 'semis' was staggering and amounted to a major change in the industry; by 1883, about one-fifth of those firms engaged in this department of the iron trade were reported to be rolling steel as well as iron. The bulk of the steel billets and sheet bars were, of course, coming in from outside the district; by the late 1890's, this was estimated to amount to some 3,000 tons each week. Not surprising, in the period of intense foreign competition after 1898 the Continental and United States steel firms sought to win the Black Country market for themselves. One significant result of this move towards the greater use of steel was that any degree of vertical integration which had existed in the way of puddling furnaces and rolling mills was lost. Just as the district's puddling furnace

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(69) W.K.V. Gale, The British Iron and Steel Industry, p. 115.

proprietors had gone outside for their supplies of pig iron, so, now, the rolling mills were becoming increasingly dependent upon outside supplies of their "raw material". The whole character of the Black Country iron trade was thus changing.

Dr. Warren suggests that the years 1894-95 were the "transition years from iron to steel in the sheet trade"(70), although, as he frankly admits, not all the Black Country firms engaged in the trade would have agreed with this assessment. Even two of the district's large producers - the Wolverhampton Corrugated Iron Company and John Lysaght's - had recently expanded their wrought iron capacity. What was true of the sheet trade was also very largely the case with tube-making. Iron strip had been the raw material of the tube-makers, whether they were making gas or steam tubes (the wall thickness needed to be heavier for steam and was painted red). The metal used in the manufacture of tube fittings was also wrought iron (known in the trade as socket iron), and since welding played a large part in the manufacturing process there was a tendency to persevere with wrought iron. What broke the resistance to the use of steel in the local industry was the increasing amount of foreign steel strip being made available in the 1900's. In 1907, for example, an average-sized firm was reported to have received 1000 tons of steel strip in one order(71), whilst early in the following year German steel strip for gas tube manufacture could be obtained for £6 per ton delivered. Even the largest works in the district - Stewarts and Lloyds - took advantage of the cheap foreign steel to teach the Gas Tube Strip Association a lesson about high prices. 16,000 tons of Belgian strip was purchased in one order.

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(70) K. Warren, op cit, p. 55.

(71) Colliery Guardian, 1/11/07.

Obviously, the change-over to steel from wrought iron did not take place without serious disturbance in some sections of the finishing department of the Black Country iron trade. Perhaps the most important factor was a locational one. Dr. Warren has recently traced the effects on the sheet industry and emphasises, as, indeed, numerous contemporary observers pointed out, that the change-over to steel encouraged a move by the sheet-makers to a coastal site. The need for this move was accentuated with the arrival in this country of so much imported semi-finished steel although, for some time, imported steel 'semis' also had the effect of maintaining the competitive nature of the Black Country firms. It is, indeed, the case that a number of local firms abandoned the area altogether, the most important being John Lysaght and Sons, the Wolverhampton Corrugated Iron Company and the Birmingham Corrugated Iron Company. Other firms sought alliances with their counterparts in other districts - notably South Wales - through a process of horizontal or vertical integration. Both Nettlefolds and E. & P. Baldwin, for example, obtained works in South Wales, whilst retaining important interests in the Birmingham-South Staffordshire district.

## Chapter 2. The Plant.

For convenience in handling the details, the plant necessary for the production of iron and steel has been divided into its various sections:

1. Blast Furnace Development;
2. Puddling Furnaces;
3. Steel Equipment;
4. Rolling and Sheet Mill Equipment.

However, it cannot be too greatly emphasised that the more efficient production of iron and steel was carried on in an integrated works and that much of the ancillary equipment performed more than one function. No aspect of the iron and steel industry after 1850 was more international in scope than the details relating to technological advance, and for this reason the treatment of Black Country iron and steel plant is made in the light of best iron and steel practice regardless of its place of origin. Unfortunately, the Black Country contributed little to what was perhaps the most exciting development in the industry in the period 1850 to 1867. Kelly in the United States; Bessemer and Mushet in England; the brothers Siemens, natives of Germany (if British by adoption and experience); Emile and Pierre Martin in France and G6ransson in Sweden firmly laid the foundations of the age of steel.(1)

### Blast Furnace Developments.

After the numerous changes to furnace design made in the Black Country in the 1830's, an excellent account of which is given by W.K.V. Gale(2), very little additional progress was made. Furnacemen saw no reason why they should risk loss of production and possible serious damage to the furnace structure in experimenting with new ideas. By the mid-century (and probably not more than twenty new furnaces were erected in the

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(1) H.R. Schubert, The Steel Industry, p. 67, History of Technology, iv,

(2) W.K.V. Gale, The Black Country Iron Industry, pp. 58 - 82.

next fifteen years or so), the average Black Country furnace stood about 45 to 50 feet high. Examples of small, isolated furnaces were to be found, producing from 75 to 100 tons of pig iron per week, but, according to Jones, it was common practice for most plants to have two or more furnaces producing from 130 to 150 tons per week.(3). Slightly larger furnaces existed which, in fact, produced between 200 and 250 tons of pig iron in the same space of time. The size of the furnace was regarded as being the "most suitable" bearing in mind "the quality of ores used in South Staffordshire". Even the very partisan W.K.V. Gale has to admit that Black Country blast furnace practice in the 1850's and 1860's was not altogether satisfactory. S.H. Blackwell wrote in the Midland Counties Herald in June 1861 that local ironmasters "certainly must not blind themselves to the progress which the manufacture of iron has made during the last twenty-five years".

What, in fact, was the progress being made in blast furnace design and practice outside of the Black Country? Abroad, Continental producers were imitators of British design (frequently that of South Staffordshire) rather than innovators. However, it is clear from the public furor over the Paris Exhibition(4) that best Continental blast furnace practice had begun to differ from that to be seen in the United Kingdom. It is, indeed, the case that one of the reasons why Northants ore never found favour in the Black Country was because it was 'different' from the local clayband ores; furthermore, the district could boast of no chemist with practical knowledge of the industry who might have been able to offer a scientific solution to the local ironmaster. South Staffordshire blast furnace practice was, in fact, governed by routine, especially

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Editor S. Timmins, op cit, p. 67. See Figures 1 & 2.

(4) The Times, 30/5/67 and Annual Report of the British Association, 1867, pp. 34 - 42.

the routine habit of using adjacent ore and coal supplies. Should anything occur to upset this routine (oolitic ores instead of clayband for example) then there was every possibility that the pig iron thus produced would be of doubtful quality. At le Creusot, in France, however, scientific control of the blast furnace process virtually guaranteed the production of a uniform quality of pig iron regardless of the varieties of ore used.(5)

Fuel economy in the production of pig iron was not something that, hitherto, had greatly concerned the majority of Black Country ironmasters; the cheapness of local coal supplies was no doubt sufficient reason for this state of affairs. Jordan, indeed, singled out South Staffordshire for criticism with regard to its wasteful fuel practices; as many as 30 to 40 hundredweights of coke per ton of iron made was consumed. The reluctance on the part of Black Country ironmasters to use Neilson's hot blast is illustrative of the two factors already referred to; as an innovation it interfered with routine practice and, in any case, coal was cheap. But even by the early 1850's, it must, indeed, be a doubtful point that fuel was cheap in the Black Country; hot blast had become general throughout the district but it had not brought the same degree of fuel economy there as had occurred in Scotland. What amazed Jordan even more, however, was the fact that Black Country blast furnaces remained open-topped; little or no attempt had been made to take off the waste gas for firing either the stoves or the boilers. W.K.V. Gale, after outlining early attempts in the district to take the gases from the furnace top(6), suggests that the reason why Black Country furnacemen had left their furnaces open was the difficulty of the task together with the fact that so much slack was available for firing boilers and

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(5) Samson Jordan, Revue de l'Exposition de 1867, iii, 1869. See D. Burn, op cit, pp. 5 - 8, for discussion on this.

(6) W.K.V. Gale, The Black Country Iron Industry, pp. 83 - 84.

stoves etc.. Jones and Blackwell are the sources for this information; many "practical men" were, indeed, of the opinion that "the economy in slack is not sufficient to compensate for the heavy expenditure in putting up and in maintaining the apparatus in working order".(7). Equally important, too, was the lay-out of the average Black Country works; for effective use of the blast furnace gases some reorganisation (including re-building) would have been necessary. It was not simply a question of fixing apparatus to the top of the furnace. By refusing to reorganise their works, many Black Country ironmasters were, in effect, hastening their own downfall. Such an attitude, too, meant that the district was falling further behind best Continental and United Kingdom practice.

In the twenty years after the mid-century, blast furnace design and practice underwent what amounted to a minor revolution. The key area as far as the United Kingdom was concerned was in the north-east - the Cleveland district. The firm of Bolckow Vaughan opened up the Cleveland district in 1850-51 with the construction of three blast furnaces at Middlesbrough, quickly followed by the Clarence Iron Works of Messrs. Bell Brothers. Furnaces designed on the South Staffordshire model were

<u>Year</u>	<u>Company</u>	<u>No. of Furnaces</u>	<u>Height (ft.)</u>	<u>Width of boshes</u>	<u>Cubic Capacity</u>
1851	Bolckow Vau.	3	42	15	4,566
1853	Bell Bros.	6	47½	16½	6,174
"	Bolckow Vau.	6	54	15	7,166
1854	Cochrane & Co.	4	55	16	7,175
1870	Bell Bros.	4	80	25	25,000
"	Cochrane & Co.	2	90	30	41,149
"	B. Samuelson & Co.	2	85	28	30,000
1871	Bolckow Vau.	2	95½	24	28,950

(8)

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(7) Editor S. Timmins, op cit, p. 67.

(8) Material extracted from Ure's Dictionary of Arts, Manufactures and Mines, edited by Robert Hunt, 1878 edition, vol. 2.

at first erected in the new areas - the first in the Cleveland district was a mere 42 feet in height - but in the 1860's some important changes came about. Thomas Whitwell built three furnaces at Thornaby in 1861 60 feet high, and the following year Bolckow Vaughan increased the height of one of their furnaces to 75 feet, but with a capacity of only 12,000 cubic feet, nearly 1,000 less than Whitwell's furnace. However, a few years later, Bolckow Vaughan built a furnace 96 feet high and without further alteration achieved a capacity of 29,000 cubic feet. Cochrane went on to surpass this; his 92 feet high furnace had a capacity of 42,500 cubic feet.(9) At Ferry Hill, in Durham, one furnace reached a height of 106 feet.

In ten years, therefore, the height of the blast furnace had virtually doubled and a tremendous increase in the cubic capacity had been achieved. Although not in the same proportion to the increased capacity, the average make of the furnace, nevertheless, rose from 400 to 500 tons of pig iron per week. The furnaces also worked more readily and tremendous savings were achieved with fuel consumption - Gjers estimated a 10 cwt. saving per ton of iron made in the Cleveland district as a whole. It was possible to make a ton of pig iron with as little as 17 cwt. of coke.(10) Because Cleveland furnaces were built so high changes had to be made to their form. The old form of furnace, built of massive masonry, "with an external shape of a truncated cone resting on its base", was unsuitable for such large structures; a lighter form of construction, with a wrought-iron cylindrical casing, supported upon cast-iron pillars, was adopted.(11) The walls of the furnace and the lining of the hearth were made much thinner than before, "the internal shape of the lining being to a great extent preserved by the cooling effect due to the atmosphere, and radiation through the <sup>the</sup> inner walls of the furnace".<sub>L</sub>

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(9) J.I.S.I., 1871, p. 202 - the drawings are especially good.

(10) Ure, op cit, p. 977.

(11) T. Turner, Iron, The Metallurgy of, 1908, 3rd. edition, p. 49.



Of the subsidiary improvements in blast furnace practice which occurred in the 1860's, perhaps the most important was the Cowper hot-blast stove. In the older forms of hot-blast stove the air was heated by passing through a series of cast-iron pipes, and only a moderate temperature could be obtained owing to the danger of melting the pipes. E.A. Cowper, the friend of Siemens, indeed, invented a fire-brick stove on the regenerative principle, heated by the waste gases from the blast furnaces; in other words, the furnace was made to heat its own blast. T. Whitwell also achieved the same result, though with a different construction. As in the case of increased height the main effect of the hot-blast stove was a great saving on fuel consumption. Besides, "an increased yield was obtained corresponding to the diminished fuel consumption"(12); this amounted to almost a 20 per cent increase in output.(13) J.S. Jeans estimated, however, that in 1882 a mere 112 out of a total of 968 furnaces erected had either Cowper or Whitwell stoves. Only a minority of British ironmasters had accepted the benefits of increased hot blast. Sir Lowthian Bell, from the start, had strenuously opposed the economy aspects of hot blast and, later, supported his assertions on spurious scientific grounds.(14) Other ironmasters, for example T.I. Smith of Barrow, had found it difficult to work at high temperatures on account of the valves giving way. Whitwell took pains to point out that such difficulties were unnecessary because "at the Clarence Works four furnaces were in full blast with 80 of his water valves and seals. Of these 40 had been at work for nearly a year and a half, with blast from his fire-brick stoves at a temperature of from 1,200 degrees to 1,450 degrees without any failure of the apparatus".(15)

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(12) T. Turner, op cit, p. 32.

(13) J.I.S.I., i, 1882, p. 135.

(14) J.I.S.I., ii, 1872, pp. 185-202 for full discussion on the subject by members of the Institute.

(15) Ibid, p. 193.

Meanwhile, there was not a great deal of new building in the blast furnace department in the Black Country - the notable exception being the erection of the Round Oak Works - but some works were modernised or extended following a change of ownership. Here and there throughout the district half-hearted attempts were made to bring the ironworks into line with some of the more progressive ideas of the period. Indeed, one contemporary furnace manager listed the following improvements in his note-book - new and improved blast engines, collection of waste gases which were then used for raising steam and heating the blast, etc. (note Addenbrooke and Millward's patent), calcining of iron ore in vertical running kilns, slag run into tubs (instead of into a pit, a practice which had led to the congestion of materials near the blast furnace), larger and improved stoves for heating the blast to temperatures of 800° to 1000° F, and closed foreparts(16) used in furnaces.(17). Whilst it is true that some, if not all, of these improvements could be found in the district, they were definitely not widespread, and the list on its own can be misleading. For example, only three of the 126 furnaces in blast in 1860 made use of the waste gas(18); in 1866 twenty furnaces were

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(16) W.K.V. Gale believes that the closed forepart was the "greatest innovation in blast furnace practice to be introduced between 1850 and 1900", op cit, p. 111. It was not a British innovation - patented in the United Kingdom in 1867 by Carl Holste on behalf of F. Lürhmann - but was first used in the Black Country at the Willenhall Furnaces of Fletcher, Solly and Urwick in 1869. In fact, only a minority of ironmasters adopted the closed forepart.

(17) F.W. Hackwood, Wednesbury Workshops, 1889, p. 119.

(18) Proc. Inst. Mech. Eng., 1860, pp. 25 et seq.

equipped for the purpose and as late as the 1880's only the same number were completely closed.(19) Jno. W. Hall's description of the Black Country emphasised this poor performance:

"For many years to come, indeed, nearly every blast furnace in South Staffordshire was a huge torch flowing to the heavens, making the Black Country almost as light by night as it was by day".

Where the Black Country furnace differed most from those in the Cleveland district was in size; only John and George Onions had attempted to follow the Cleveland lead and try to achieve economy of production through greater size. In 1870, they erected a blast furnace 74 feet high and 13 feet in the boshes, which was charged by an inclined plane 110 feet long. Furthermore, most of the ancillary equipment for the effective running of the blast furnace was of recent design.(20) Unfortunately, the Onions' brothers had to go into voluntary liquidation six years later, "a fate", writes W.K.V. Gale, "of many others whether they tried to modernise or not".(21) With the South Staffordshire district becoming so dependent on outside supplies of coal and coke - and iron ore- there was no reason why blast furnaces should not have been built along the larger lines.

It might be thought that because the Black Country industry chose not to follow Cleveland's lead and build large furnaces it did not give itself either the opportunity to employ the new ancillary machinery which was so essential to up-to-date blast furnace practice or to bring in innovation. However, if we look at developments on the Continent in the early 1870's we can see that this need not have been the case. Before doing this briefly, though, it is worth pointing out that the

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(19) In fact, the Black Country, with about 16 per cent of its furnaces closed, slightly bettered the national figure of 11 per cent.

(20) The Engineer, 20/5/70.

(21) W.K.V. Gale, The Black Country Iron Industry, p. 117.

Cleveland district also gave the impression of stagnation in blast furnace practice after the mid-70's:

"With their attention focussed on these two elements of blast furnace practice (furnace dimensions and heat of blast), and perhaps with a tendency to place economy in coke consumption on too isolated an eminence, the progressive ironmasters of Cleveland failed to experiment seriously in these years in other elements of blast-furnace work, so that, apart from the adoption of a German system of slagging (with Bell in characteristic opposition), the form and proportions of the best blast furnaces remained little changed in the decade".(22)

In Europe, many new furnaces were built in the 1860's and 70's but, in general, they followed the Cleveland pattern except with regard to the height of the furnace. In fact, very few Continental furnaces exceeded 65 to 70 feet in height. Where they differed so greatly from United Kingdom - and especially South Staffordshire - furnaces was in the use of "superheated blast". Whereas the blast was heated to temperatures of 800 to 1000 degrees F. in the Black Country, temperatures well in excess of 1400 degrees were common on the Continent. British visitors to iron-works in France, Belgium and Germany in the 1870's were "surprised" to find that weekly makes were on average higher than those in the Cleveland district and coke consumption lower.(23) In 1874, two new blast furnaces came into operation at Maizières-les-Metz close to the Lorraine border(24); described as "18½ metres in height ... provided with Cowper's regenerative hot-blast stoves, and all modern improvements"(25), they were very soon producing between 70 and 80 tons of pig iron per day. In the Esch-sur-

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(22) D. Burn, op cit, p. 45.

(23) J.I.S.I., 1873, pp. 433-4.

(24) The area was very similar to the Northants district (sandstone ores); besides, with so much Northants ore going into the Black Country, there were similarities with that district as well.

(25) J.I.S.I., 1874, p. 437.

l'Alzette district, Luxembourg, using "uncalcined small Minette ore", the Societe Anonyme des Hauts Fourneaux was getting from 700 to 770 tons of pig iron per week from a blast furnace 65 feet high by 24 feet across the boshes.(26) Using a Whitwell stove the blast was supplied at a temperature of 1,400 degrees F., and the amount of coke required to the ton of pig iron produced was only 20 to 25 cwts. M.E. Fischer, manager of the blast furnaces, was so delighted with their performance that he wrote to Whitwell with some additional information. Between 23 July and 5 August, 1874, furnace No. 1 produced 1582 tons of pig iron, a fact which led Whitwell to comment: "It is probable that this example of iron smelting has not been excelled in any part of the world".(27)

In 1898, Horace Allen spoke to the South Staffordshire Institute on "The Blast Furnace as a Source of Power". Introducing his subject, Allen said that the blast furnace was "a symbol of industrial progress":

"... if one desired to determine the comparative position in the scale of industrial supremacy of any given nation, an interrogation as to the yearly output of its blast furnaces would, in the answer given, provide all the data for comparison".(28)

He went on to review the stages "in the evolution of the modern furnace" - the introduction of hot instead of cold blast by Neilson, the perfection of the system by Cowper, Whitwell, Crook and others; the utilisation "of the waste blast furnace gases in the flues of steam boilers". Then he said:

"More recently the scene of experiment in blast furnace practice has been removed to the United States, and the plant at Duquesne, in Pennsylvania, contains, in its gigantic equipment, many improvements

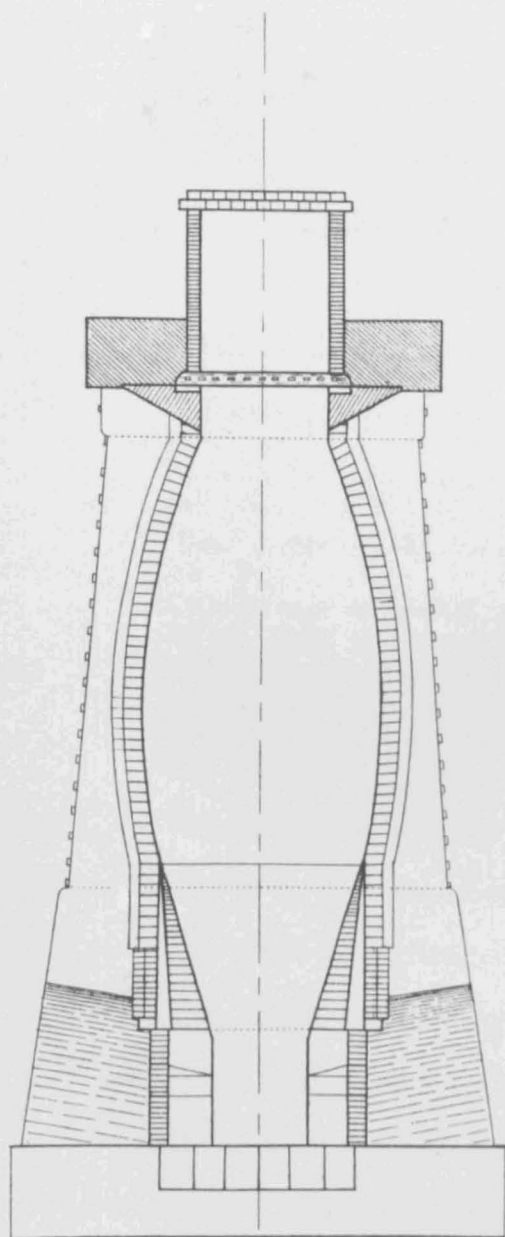
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(26) Ibid, p. 438.

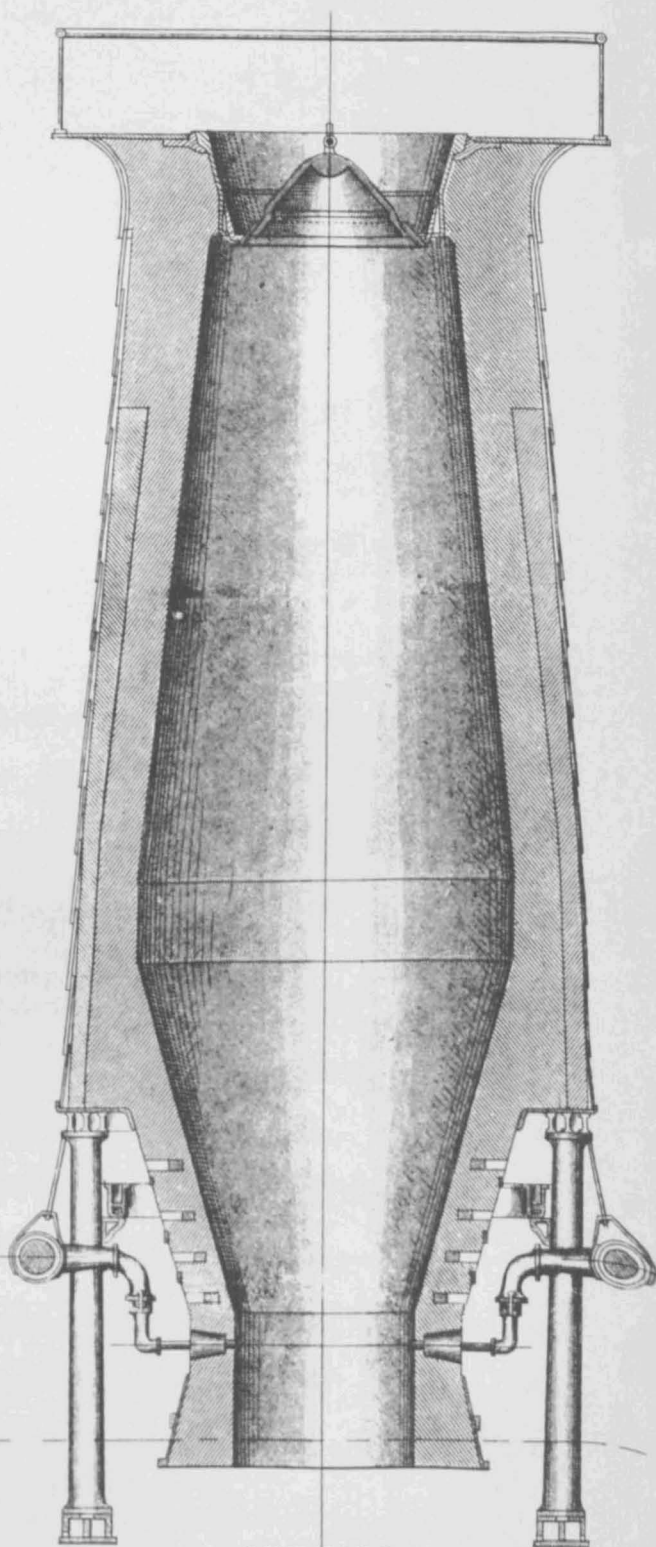
(27) J.I.S.I., 1875, p. 620.

(28) Proc. S. Staffs., 1898-9, p. 2.

BLAST FURNACE  
DESIGN



STAFFORDSHIRE  
1860



AMERICA  
1890

of detail that have led to a cost of production, that is, in its possibility of economic rivalry at the place of manufacture, quite above the plane of European competition."

Indeed, changes brought about by the United States industry to blast furnace design and practice after 1870 exceeded those which had been made by Cleveland ironmasters to the Black Country furnace in the twenty years before 1870. Conditions in the United States were different from those in the United Kingdom, particularly in the nature of the rich Lake ores; tremendous expansion occurred, stimulating innovation and creating an entirely new atmosphere in blast furnace practice. As early

Blast Furnace Practice in Britain and the U.S.

<u>Britain</u>	<u>United States</u>
Mostly within 20 miles of sea	Mostly in W. Pennsylvania, 400 - 500 miles from sea
Furnaces of small dimensions	Generally of large dimension
Average furnace output per year = c.25,000 tons	60,000 tons
Usual pressure of blast 4-6 lbs.	10-12 lbs.
Average ore consumed per ton of iron made = c.2½ tons	1½ tons
Small volume of blast	Large volume of blast
Furnaces have long life	Furnaces have short life
Average % of iron in home ore = 38	50
	(29)

as 1871, the Struthers furnace in Ohio had attracted attention in the United States for what was then a very large make - 1602 to 1642 tons per month, or just in excess of the furnace managed by Fischer on the Continent. By March 1876 the production had increased to 2032 tons per month, and the only change to the plant had been the addition of a second blowing machine.(30) Sir Lowthian Bell had grudgingly admired American blast furnace practice on his visit to that country in 1875; he believed that former American visitors to Britain had "known how to

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(29) Proc. S. Staffs., xviii, 1902, pp. 39-59.

(30) J. Gayley, The Development of American Blast Furnaces, with special reference to large yields, J.I.S.I., 1890, ii, p. 18.

profit by the results of our experience in the counties of Durham and Yorkshire".(31) The Isabella and Lucy furnaces of Carnegie, Phipps and Company were then producing on average 600 tons and above a week, which "was 200 tons more than the average make in Cleveland". Bell believed that the American secret lay "in forcing in the air at a high pressure, 8 - 9 lbs., and in immense volume".(32) He was critical of the fact that "a sacrifice of five cwt. and more of fuel" per ton of iron was necessary "for this unusually large production". Bell had, indeed, hit upon the sharpest difference between English and American practice. The Cleveland ironmaster had been concerned with fuel economy; the American manager was in pursuit of a high make even if it meant heavier fuel costs than were customary in England and a shorter life for his furnace stack. This latter point proved extremely troublesome over the next twenty years or so, but most of the problems were eventually overcome.

Julian Kennedy, <sup>a</sup>manger of the Edgar-Thomson works, was the first person to construct a furnace on "a liberal basis" with the prime intention of going for large yields. To enable the furnace to withstand the rigours of hard running, Kennedy strengthened the brickwork of the stack with "eight-inch bands supported by staves of T-iron, forming a crinoline".(33) The bosh walls received the same treatment and the "walls of the hearth were surrounded by solid cast-iron plates, securely bolted, no cooling plates of any kind being used". All the furnace ancillary equipment was carefully adapted for the purpose in hand; fire-brick stoves of the most recent design were erected, strongly built blowing engines were provided, together with "an ample supply of boilers - a point in which other furnaces were then sadly lacking". Finally, "all the flues and mains were constructed sufficiently large, and in the most substantial way".

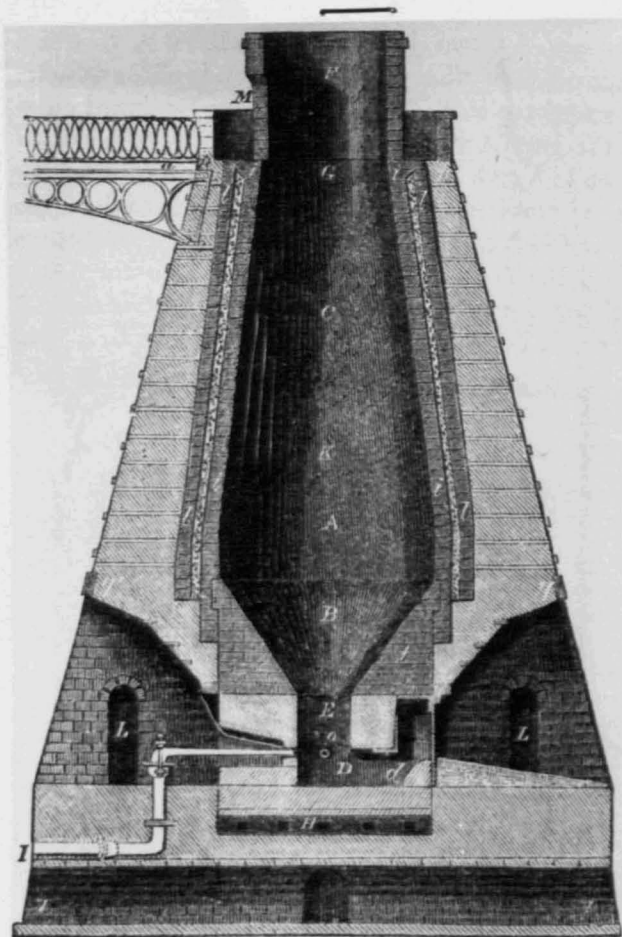
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(31) J.I.S.I., 1875, pp. 117-8.

(32) *Ibid*, p. 118.

(33) J.I.S.I., 1890, 11, p. 22.





SECTION OF BLAST FURNACE.

FIG. 6

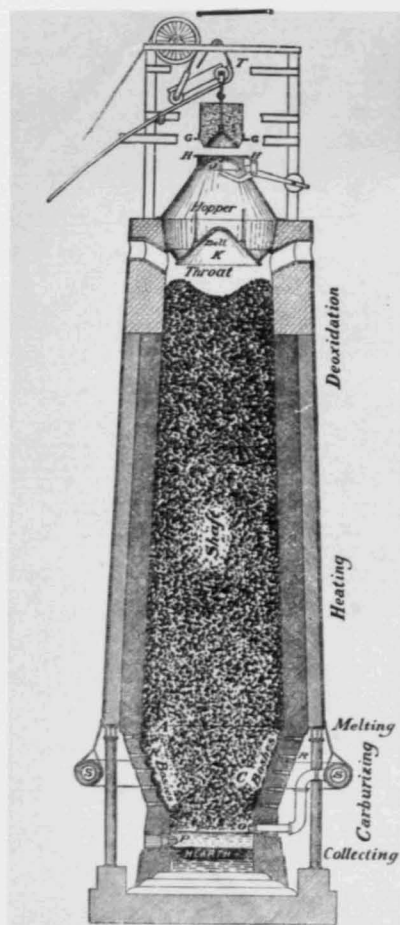


FIG. 7.—Section of Bessemer Blast Furnace.  
GG, Flanges on the ore bucket; P, Cinder notch;  
HH, Fixed flanges on the top of the furnace; R R', Water cooled boxes;  
I, Counterweighted false bell; S, Blast pipe;  
K, Main bell; T, Cable for allowing conical  
O, Tuyere; bottom of bucket to drop.

FIG. 7.

All previous records of production, now a very important issue amongst the American ironmasters and their managers, were eclipsed by Kennedy's furnace, "thus fully justifying the claims of its designers".(34) Monthly makes of between 2536 and 2811 tons of pig iron were achieved between April and October of the same year. The increased rate of driving - the volume of air blown was increased to 30,000 cubic feet - made fuel consumption high; this was largely expected but what was disappointing was the rapid wear of the furnace walls. The upper brickwork of the stack gave way and the furnace was blown out after a blast of two years and five months. In that time, 112,060 tons of iron had been produced on an average coke consumption of 3,149 lbs. per ton of iron.(35) To some extent, Kennedy had underestimated the strains placed upon a furnace as a result of the rapid driving, and when next a furnace was built at the Edgar-Thomson Works the crinoline structure around the stack was replaced by "an iron jacket", the bosh walls were further strengthened and the hearth surrounded with water-cooled plates. Having planned for the strengthening of the furnace the problem of weight had to be overcome; the hearth would not be able to support the heavier furnace lining and the superstructure. The weight problem had, indeed, led to changes in the Cleveland district in the 1860's and 70's. In the United States in the 80's and 90's the best method of dealing with the weight problem was found. To relieve the lining of the weight of the bell, hopper and platform the following structure was added:

" ... consists of three rolled joists bent to the circle of the furnace, and which supports an ordinary flat lintel plate upon the tops of the columns, and which easily carry any extra weight likely to be thrown upon them by accident, or uneven settlement".(36)

In order to preserve the internal shape of the furnace, brickwork was

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(34) Ibid, p. 23.

(35) Ibid, p. 24.

(36) Proc. S. Staffs., 1891, p. 9.

as thin as possible. H. Pilkington, when President of the South Staffordshire Institute, believed that the Americans had "as usual" come first in this practice: "their brickwork in no case exceeds 36 inches, and it is often only 24 inches thick".(37) Pilkington was also most impressed by the way the Americans had solved the problem of "cutting ... at or about the tuyeres"; they had not followed the European practice of overhanging the tuyeres, but by "an elaborate system of water cooling, by means of tuyere breasts and blocks". Only the very best English practice could match the Americans on this point. Problems had always been encountered in keeping the bell of the furnace in the centre, so that when it was lowered an equal distribution of material was made all round the furnace. On this point, Pilkington again felt that the Americans had achieved more success than the English in working the bell "by an overhead steam or hydraulic cylinder".(38)

By the mid-1880's, even the Americans themselves were beginning to question whether or not too much was being sacrificed in the interests of high yields. E.C. Potter of Chicago was the first to tackle the problem with any degree of success; he showed that it was possible to have large yields and a low fuel consumption at a time when "it was thought well nigh impossible to produce a ton of iron with 2,600 lbs. of coke".(39) Gayley attempted to follow Potter's lead and by reducing the blast from as much as 33,000 to 28,000 cubic feet per minute he was able both to increase the monthly make and reduce the coke consumption of the furnaces under his control. He went on to make further modifications, especially in the use of water-cooled plates to protect the shape of the hearth; the volume of air blown into the furnace was steadily reduced although the temperature of the blast was increased. Much to Gayley's satisfaction, he was able to improve on all previous furnace makes at a greatly reduced average coke consumption. Not surprisingly, he concluded his address

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(37) Ibid, p. 10. See Figures 5, 6 & 7.

(38) Ibid, p. 11.

(39) J.I.S.I., 1890, ii, p. 25.

to the Iron and Steel Institute on the occasion of the latter's meeting in the United States in 1890 thus:

"In the period covered by the last decade there are three steps in the development of American blast furnace practice that might be mentioned - first, in 1880, the introduction of rapid driving, with its large outputs and high fuel consumption; second, in 1885, the production of an equally large amount of iron, with a lower fuel consumption, by slow driving; and third, in 1890, the production of nearly double that quantity of iron, on a low fuel consumption, through rapid driving".(40)

In fact, the occasion of the 1890 meeting brought the United Kingdom industry face to face with the progress made in the United States. Following the presentation of Gayley's paper on American blast furnace practice a long discussion took place on the topic between American, British and European manufacturers. During this discussion many of the reasons why the British industry could not match the American methods of production became clear. Bell, as usual guarded in his praise of a foreign competitor, admitted that perhaps the English "had overlooked some of the conditions involved in smelting the ores of iron, for we have not only to consider the low consumption of fuel ... but the hitherto unparalleled large production of iron from one furnace".(41) The basic difference in furnace practice centred on the following formula:

English practice : Economy of fuel, First; Production, Second

American " Large Production, First; Fuel Economy, Second

Crucial to this difference were the contrasting characteristics of American and English attitudes to management problems, especially with regard to the utilisation of labour. G.J. Snelus, perhaps the most obvious admirer of American methods, admitted that he had always been

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(40) J.I.S.I., 1890, ii, p. 35.

(41) Ibid, p. 37.

an advocate of rapid driving but his difficulty had been that "he could not drive quickly":

"... the men would not be driven, the manager would not be driven, and the furnace would not be driven, because they had not got the plant, and could not get it".(42)

He thought that the "life of the furnace ... should be a short and merry one", particularly if you could save, as the Americans had done, four hundredweights of coke to the ton of iron in the process:

"this amounted to about £25,000 a year on this particular furnace; surely that was enough money to re-line the furnace two or three times over!"

Unlike E.W. Richards of Ebbw Vale, who had criticised Carnegie and other Americans for trying "to beat the record ... with more water-blocks, more fire-brick stoves, more blast engines, more batteries of boilers"(43), Snelus found nothing wrong with "the wonderful spirit of emulation among the proprietors, the managers, and the men":

"... he, for one, would only be too glad, as an Englishman, if English managers, proprietors, and men could get contaminated with the same spirit, and he might add that he should be very pleased to carry the influence away with him".

Twelve years passed before the British industry made another full report on the American industry. On behalf of the BITA Axel Sahlin had, indeed, undertaken to study, amongst other things, American blast furnace practice. It was soon abundantly clear to him that the Americans had made further great improvements since 1890. More than fifty per cent of blast furnace plants in operation in 1892 had since been blown out - their places taken by a smaller number of giant furnaces "equipped regardless of cost, but with the strictest eye to economy and efficiency

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(42) J.I.S.I., 1890, Special Volume on the United States, p. 61.

(43) *Ibid*, p. 51.

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of operation". The cost of a furnace stack and its equipment was between £160,000 and £300,000. The Americans were working on the assumption that "a blast furnace lining is good for a certain amount of wear, that is, a certain number of tons of iron, and that the sooner this quantity of iron is made, the better the furnace will pay for itself".(44) Many furnacemen maintained that the amount of blast forced into a furnace had not yet reached its limit, though Sahlin found that some of the larger furnaces were working under an average pressure of between 18 and 22 lbs. and receiving from 50,000 to 70,000 cubic feet of air per minute. The high volume of blast, claimed the Americans, "has the effect of making the furnace work uniformly all over, and prevents dirt troubles, slips and irregularities". Full instrumentation - "self-registering pyrometers, recording gauges and instruments" - placed before the manager at all times "graphical reports of cold blast pressure, back pressure in the furnace, temperature of blast from each stove, temperature of outgoing gases at the top of the furnace, steam pressure, volume of blast, number of skips hoisted, and height of stock line in the furnace".(45) A most important development concerned the use of the "mud gun", or tap hole closing machine, with which the iron was cast without taking blast off the furnace - "from 40 to 60 minutes per day are saved, and the output from the furnace is correspondingly increased". Sahlin recorded that at one of Carnegie's plants - the Carrie Plant Furnaces - a single furnace had produced as much as 790 tons of iron in one day.(46)

In the period when the Americans were setting the pace, nothing like the same amount of progress was achieved by the British industry. Iron and steel works visited by the Iron and Steel Institute in the 1890's, including those at Consett, Tudhoe, Dowlais and Cyfarthfa, seemed to be-

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(44) BITC Report, 1902, p. 483.

(45) Ibid, p. 484.

(46) Ibid, pp. 488-90.

long to a different era. Many of the furnaces inspected by the Institute visitors were over thirty years old - some were built on early and mid-eighteenth century foundations - and none possessed ancillary equipment to match that to be found in general use in the United States.(47) Blast pressures varied between  $4\frac{1}{2}$  to 6 lbs. per square inch and temperatures between 1300 and 1400 degrees F.. At Consett, the weekly average make was around 750 tons for each furnace - from 'pure' Spanish ores - though a single furnace had once produced 919 tons of Bessemer pig iron, whilst at the Cyfarthfa works the average output was 800 tons of hematite iron. Even allowing for the many differences which existed in the nature of the two industries, admirably discussed by Duncan Burn, the United Kingdom was sadly behind American blast furnace practice.(48)

Developments in Black Country blast furnace practice within the same period and up to 1914 have been sadly neglected by writers on the industry. Even W.K.V. Gale passes briefly over the subject with the exception of his rather extavagant claims for the closed forepart - "the greatest innovation in blast furnace practice to be introduced between 1850 and 1900".(49) However, a great deal was going on and a few of the remaining furnacemen at the turn of the century had achieved considerable success, which they tended to maintain until 1910 at least. As with many other aspects of the local scene, Sir Alfred Hickman was well to the front. Hickman ignored the large constructions, either on the Cleveland or the American pattern, largely because he wished to produce a variety of pig irons; consequently, he opted for a number of smaller furnaces. In 1895, when visitors from the Iron and Steel Institute looked at his Spring Vale works, he had some of the most up-to-date blast furnaces in the district:

"The blast furnaces which are in two groups, are among the largest

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(47) J.I.S.I., 1893, ii, p. 152; 1897, ii, p. 230 and pp. 237 - 8.

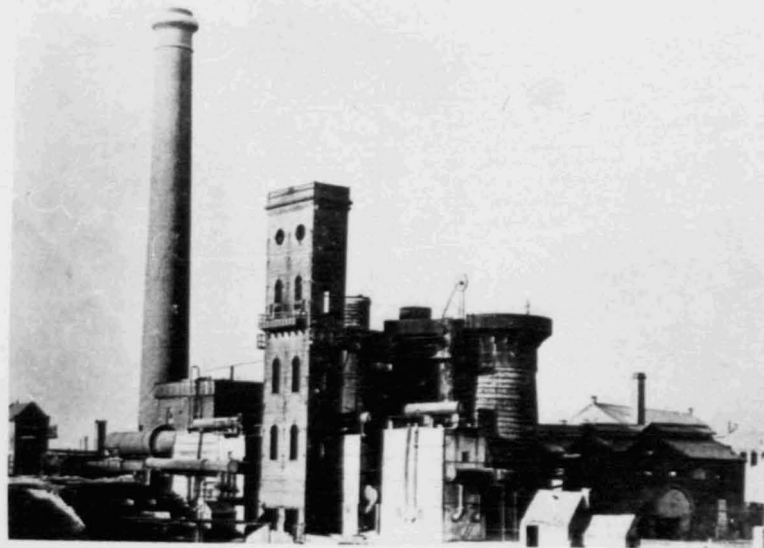
(48) D. Burn, op cit, pp. 188 - 192.

(49) W.K.V. Gale, The Black Country Iron Industry, pp. 111 - 114. See also Figures 8 and 9 .



Two nineteenth-century blast furnaces. They were lift-charged from the back. The gas offtake pipes (near the top), the bleeders or 'monkeys' (particularly top right), the forepart arch, and one of the pig beds can all be seen

FIG. 8.



Three late-nineteenth-century blast furnaces. These were charged by a vertical lift (in the tower) instead of an incline. To the right and left of the lift tower are pipe stoves for blast heating and on the right the cast houses

FIG. 9.



in the district, being 65 feet high, 18 feet in the boshes, and 9 feet in the hearth, working with closed tops and Cowper hot-blast stoves".(50)

The furnaces were of the iron-cased type, with a cup and cone arrangement to close the top; the waste gases were used to heat the Cowper stoves and the waste heat boilers and blast temperatures of up to 1500 degrees F. were used. The outstanding feature of Hickman's blast furnace management was undoubtedly the care and attention which was given to the twin problems of fuel economy and the recovery or utilisation of by-products. The economy-from-large-makes was not Hickman's way; rather did he plug away at what might, at first sight, have appeared as minor issues. In the early 1890's, for example, B.H. Thwaite took out patents for cleaning the blast furnace gas and making it suitable for use in the internal combustion engine. In many ways, he was working in the traditions of Neilson, Cowper, Whitwell, Crook and others; like so many pioneers before him, when Thwaite put his ideas before the ironmasters of the day "they simply ridiculed the idea that gas, that would fail occasionally to light in large volumes in the flues of steam boilers, would enflame with the rapidity required in the water-cooled cylinder of a gas engine". (51) Hickman was to be found among the few who did not laugh, but instead he installed one of the earliest gas engines in the United Kingdom.(52) The gas was passed through large cylindrical towers where the heavy particles fell, then through a series of water sprays generated in rapidly revolving fans. As well as driving the engines which forced air to the blast furnaces at a pressure of 5 lbs. per square inch, the gas was used to generate sufficient electricity for lighting the works, driving rolling mills and other types of machinery. Hickman had gone

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(50) J.I.S.I., 1895, ii, p. 334.

(51) Proc. S. Staffs., xiv, 1898, p. 4.

(52) T. Turner, op cit, p. 188.

a long way towards meeting Horace Allen's description of new blast furnaces:

"Instead of these industrially centred blast furnaces having to be blown out by the rival and modern colossal furnaces, which are magnificent examples of American enterprise, the smaller furnaces well distributed in centres of power demand will be able to continue their useful existence proving in addition to the democratic metal - pig iron - all the power and light requirements of a manufacturing centre and under the most satisfactory conditions; so that although the great lights from the mouths of our blast furnaces have been extinguished by the hand of science, the light will still be given in a better way to all the homes and workshops - within a radius of 25 miles from the ironworks".(53)

Hickman not only put to good use "upwards of 120 million cubic feet of gas per week" from each of his furnaces, but he also found a use for the potash from the dust in the furnace gas. Together with that which settled under the boilers and in the Cowper stoves, this "flue dust" was sold to farmers as a fertiliser. So, too, with the sale of basic Bessemer slag as a fertiliser; as early as 1886, Hutchinson stated in a paper to the British Association that the basic slag from the South Staffordshire Ingot Iron Company "bids fair to become an important manure".(54) Finally, Hickman's unfailing ability to turn waste materials into capital - and so reduce the cost of producing his pig iron - was well illustrated by his solution to the continued problem caused by slag accumulation. He turned some of the slag into a suitable railway ballast, whilst the other was turned into a valuable road-making material.(55)

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(53) Proc. S. Staffs., xiv, 1898, p. 13.

(54) J.I.S.I., 1886, 11, p. 963.

(55) G.R. Morton and M. Le Guillou, loc cit, p. 19.

Towards the turn of the century, something of the American methods in blast furnace practice began to rub off on Black Country furnacemen. Not for one moment is it being suggested that the gigantic makes of the American furnaces were matched by those in the Black County, but it is interesting to note that within the space of a few years the average make in that district more than doubled. Much talk was heard of the "new" practices in the district; the temperature of the blast was increased and the pressure was raised to 8 to 10 lbs. per square inch.(56) Before the 1890's, very few Black Country blast furnaces produced more than 350 tons per week. In 1897, two furnaces belonging to Messrs. Roberts and Company were reported to have produced 825 tons of metal in one week - "probably the largest output recorded in the Black Country"(57) - whilst in the following year a new blast furnace was erected at the Earl of Dudley's Level Works which would produce in excess of 600 tons of metal per week. By the early 1900's, when local furnacemen were said to be spending "large sums" in keeping their plant "right up to-date by the erection of new or additional hot-air stoves, calcining kilns, new blowing plant, increased railway siding facilities etc.."(58), furnaces were producing between 600 and 700 tons of pig iron per week. In 1910, it was remarked in the trade press:

"... pressure of blast blown into the furnaces has enormously increased, with the result that ironmasters are getting much more iron through the furnaces than formerly. It is the height of ambition of blast furnace management at the present time to produce large outputs, which lessens the dead charges and so increases profits and dividends. In this connection, Alfred Hickman Limited, Wolverhampton, are putting in a duplicate gas-blowing engine plant to

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(56) Colliery Guardian, 26/3/09.

(57) Colliery Guardian, 7/5/97,

(58) Colliery Guardian, 31/5/07.

render themselves independent of accidents and also to increase their consumption of gas from the blast furnaces, and so cheapen output. The plant, which will run entirely on furnace gas, will be of the most modern description, and will have a free air capacity of not less than 43,400 cubic feet per minute. It will administer to the blast necessities of five furnaces".(59)

One serious shortcoming that remained among Black Country blast furnace plant concerned the assemblage and further handling of the raw materials. The whole district was very congested and the lay-out of individual plant really warranted the complete re-building along modern lines. At Spring Vale, for example, the site appeared congested and some visitors found it difficult to move about amongst the furnaces, railway sidings, stock bins, kilns and numerous other buildings and pieces of equipment. All the materials had to be man-handled from railway wagons or canal boats and taken to the furnace tops in hand barrows up inclined hoists.(60)

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(59) Colliery Guardian, 22/7/10.

(60) Frederick Scopes, The Development of Corby Works, 1968, Appendix vii.

### Puddling Furnaces.

The puddling furnace (or reverberatory furnace), dating back to Henry Cort (1740-1800), together with Hall's pig boiling or wet-puddling technique, was used throughout the Black Country, as elsewhere, in the production of wrought iron.(61) In its simplest form, the reverberatory furnace can be considered as two boxes made of refractory bricks; the success or failure of the process depended almost entirely upon the puddler who worked the furnace with a paddle and raddle.(62) Before the Bessemer era, there had not been any great urgency to bring about technical change; there was no rival product to wrought iron and by far the heaviest expense involved in the production process was the labour. So long as the puddler could produce a high quality material there appeared to be little need for change. Occasionally, though, attempts were made "to imitate by machinery the movements of the hand-operated tools", that is, to create a mechanical puddling instrument. In June, 1836, for example, Charles Shafhautl patented a machine for the puddling process, and it was tried out at the Tividale Ironworks near Dudley. From reports of the machine made a number of years after the trials, it would appear that Shafhautl's apparatus was far too complicated for successful operation.(63) Much greater importance was attached to attempts to improve upon the puddling process following the invention of the new steel-making processes by Bessemer (et al) and Siemens; there was increased attention given to the high wastage rate of fuel, pig iron and labour especially as the price of steel gradually got nearer that of wrought iron. Members of the Black Country industry played a part in what amounted to an unsuccessful programme.

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(61) See W.K.V. Gale's two works - The Black Country Iron Industry and The British Iron and Steel Industry - for the simplest description of the process.

(62) W.K.V. Gale, The Black Country Iron Industry, p. 156 for other tools.

(63) The Engineer, 5/8/64.

Because the first half of the 1860's saw great unrest amongst the puddlers as a work force, rather than because of any reaction to the Bessemer process, attention was focussed on efforts to mechanise the labour of the puddler. Two firms in the West Midlands, Lloyds, Fosters and Company at the Old Park Ironworks, Wednesbury, and the Wombridge Ironworks of Wellington in Shropshire, introduced mechanical processes but, after some early success, they were not proceeded with. This was the fate of another experimental mechanical puddler at the Regent Ironworks, Bilston, (64) although Clough's modification of the patent mechanical rabble of James Eastwood did have some limited success and a few machines on this plan were used in the Black Country. (65) Menelaus, the manager at Dowlais, had by now established a reputation for himself in this field; in 1865, he tried a rotating furnace at Dowlais. Once again, however, the rotating furnace was only half successful, although Menelaus was convinced that the numerous problems encountered during the trials would soon be ironed out.

It was largely due to the efforts of Menelaus that the newly-formed Iron and Steel Institute established a committee to look into the question of mechanical puddling in 1870. No Black Country ironmaster was on the Committee, which was made up of Menelaus and Edward Williams, both at that time from Dowlais, Lowthian Bell from the Clarence Works, Sir John Alleyne of Butterley, William Fowler of Sheepbridge and F.W. Kitson of Monk Bridge. At the Dudley meeting of the Institute an American from Cincinnati, Samuel Danks, gave a detailed account of his Rotary Puddler, which was a revolving puddling furnace, and for which he claimed a saving in both labour costs and fuel consumption in addition to a bigger yield of high quality iron. Institute members were impressed

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(64) The Engineer, 15/4/64.

(65) W.K.V. Gale, The Black Country Iron Industry, p. 106.

and it was decided that a three-man team should visit America and see the rotary puddler in operation. 'Armed' with no less than 40 tons of pig iron from the major iron producing districts of the United Kingdom (including South Staffordshire), in addition to various types of fettling materials, the three-man team visited the Railroad Mill, Cincinnati. A little surprisingly, for Danks was still encountering difficulties both with the fettling of the furnace and mechanical weaknesses, the team returned to the United Kingdom with glowing reports of the rotary puddler. (66) Messrs. Hopkins, Gilkes and Company, of Middlesbrough, was the first company in the United Kingdom to give a practical test to Danks' machine, (67) followed soon afterwards by another north-east firm, the Erimus Iron Company, Limited. J.A. Jones was managing director of this company and he tried desperately to find a solution to the "chief drawbacks to the success of rotary puddling":

"They were stated to be the education of the men, and the removal of prejudice from amongst them; the difficulty with the fettling of the furnace and the mechanical weakness of the Danks machine". (68)

Heath, Crampton and Sir John Alleyne were among a small minority of ironmasters who, by 1872, owned the 74 Danks furnaces in the United Kingdom. Alleyne, in fact, tried a number of different machines, including a modification of Maudsley's machine and a Siemens' Rotator. This latter machine, referred to as a "soup plate", was described thus:

"The machine consists of a pan, which rotates on a vertical axis, and the puddler, which is fixed over head, and which works the rabble to and fro is at right angles to the front of the furnace. When the iron

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(66) J.I.S.I., 1872, i, pp. i - xxxv.

(67) J.I.S.I., 1875, p. 17. By 1879, Hopkins, Gilkes and Company were bankrupt; the firm had supplied the iron for the Tay Bridge.

(68) *Ibid*, pp. 17 - 21.

is ready to ball up, the puddler is stopped, but the pan continues to revolve. The work of balling is done at the door, and it is never necessary to reach across the furnace".(69)

An earlier version of a Siemens gas furnace had, in fact, been tried at the Round Oak Ironworks, although there is no information on how it performed. In the early 1870's, Smith-Casson, then manager at Round Oak, experimented with a gas-fired furnace - the so-called Casson-Dormy furnace. It was not a success, and the significance of the installation of this machine was that it occasioned a serious labour dispute in the Black Country. It would appear that Round Oak was the chief centre in the district for carrying out trials to find a mechanical puddler. For whatever reason, no attention was wasted on the Danks machine. Three Griffiths 'Double Puddling Machines' and two 'improved Puddling Machines' were later acquired by Round Oak, and a description of the latter was as follows:

"Two improved Puddling Machines with cast iron frames ... revolving discs, wheel gearing fast and loose pulleys, and straps. One small pair of Vertical Engines for driving machines."(70)

Attempts to achieve mechanical puddling were no more successful on the Continent, although for a short time it did appear as if the Frenchman, Pernot, had made a significant improvement to Maudsley's furnace. Whilst the Continental experimenters, indeed, fell short of creating a wholly mechanical process, they did succeed in bringing about greater economies in labour and fuel than their counterparts in the United Kingdom. As to why there was so much failure both in the United Kingdom, the United States - Bell knew of only one other works besides the Railroad

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(69) *Ibid*, p. 23.

(70) Alexander Smith's Valuation of the Round Oak Ironworks, 1897. No mechanical puddler was then in operation at the works.



Mill to persevere with a Danks machine - and on the Continent with regard to mechanical puddling furnaces there is no one answer. Mr. Gale is probably correct in saying that they failed "for one of two reasons":

"Either they were unreliable mechanically and so impossible to keep in operation, or else they were not capable of producing good iron consistently".(71)

Metallurgical science of the 1870's and 1880's was not sufficiently advanced to match the inherited skill or 'intuition' of the puddler; when, perhaps, this could have been achieved there was no longer the commercial justification for the expenditure of capital on a material that had only a limited demand.(72) In the period 1867 - 76, no less than 389 applications were made to the British Patent Office in this field(73), and yet in 1882 J.S. Jeans told the Iron and Steel Institute:

"The puddling furnace of a generation ago is in all its essential features the puddling furnace of to-day. Both have been condemned as crude, barbarous and wasteful, and yet both continue to enjoy a measure of vitality and appreciation to which their merits have certainly not entitled them".

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(71) W.K.V. Gale, The Black Country Iron Industry, p. 107.

(72) It is of interest to note that as late as 1885 Britain was turning out more puddled iron than steel, whilst in Germany "the curves of output do not cross until 1887; and in France not until 1894".(D.S. Lands:  
The Unbound Prometheus, 1969, pp. 259-60).

(73) J.C. Carr and W. Taplin, History of the British Steel Industry, 1962, p.56. Although interest in mechanical puddling all but died out after 1880, Ebenezer Parkes was greatly impressed by Roe's gravity puddler which he saw at Pottsdown, near Philadelphia, in 1901. (1902 BITC Report, pp. 577-580.)

### Steel-making Equipment.

Henry Bessemer in the summer of 1855, at Woolwich Arsenal, succeeded in converting iron into steel. His researches had led him to try a refractory-lined and pear-shaped cylindrical vessel, open at the upper end for the escape of gases. Air would be blown into the cylinder through tuyeres, situated at or near the bottom. The oxygen of the air blast would cause the oxidation of the impurities contained in the pig iron, namely silicon, manganese and carbon.(74) When, in the following year at Cheltenham, Bessemer disclosed his findings the excitement was intense(75); however, the many difficulties which were then encountered led to a great deal of disappointment and scepticism. As a result, sixteen years later the Bessemer steel industry in the United Kingdom was still in its infancy. There were just in excess of 90 converters throughout the entire industry with a total capacity of 449 tons.(76) Apart from the Barrow Hematite Steel Company, with 108 - 114 tons, and the Sheffield firm of Jn. Brown and Company, with 65 tons, there was no firm with 'vessels' of more than 30 tons. Besides, the capacity of individual converters was small with the majority ranging from three to six tons. Jno. Brown and Company was alone in having two ten-ton converters. It would appear from Bessemer's writings that he was especially anxious to see his process accepted by the Black Country ironmasters. In general, he was, of course, to meet with disappointment as far as this area was concerned. The one person to come forward from South Staffordshire to seek a licence from Bessemer was Samuel Lloyd of Wednesbury. Four three-

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(74) "The Manufacture of Iron Without Fuel", quoted verbatim in Sir Henry Bessemer F.R.S., An Autobiography, 1905, pp. 156-7.

(75) The Times, 14/8/56.

(76) Ure, op cit, p. 1030. The material given by Robert Hunt in this volume does differ slightly from the list of converters given in the J.I.S.I., i, 1872, p. lxix.

ton converters were installed at the Old Park Works. The Patent Shaft and Axletree Company continued with the Bessemer plant when they purchased the works from Lloyds, Fosters and Company, but there were no further developments in the district with regard to the Bessemer process until the introduction of basic steelmaking by Alfred Hickman in the early 1880's.

Meanwhile, of course, a great deal happened on the steel scene, and especially outside of the United Kingdom. A Bessemer steel industry was established first in France by the firm of James Jackson and Son at their works near Bordeaux; it then spread to other districts, notably in the Centre, at the Imphy and Montlucon Works; in the Loire district, at the Terrenoire, Creusot, St. Etienne and Givors Works; and in the Gard district, at the Besseges Ironworks.(77) Belgium also was not far behind her neighbour, the first Bessemer converters being set up at Liege. In Germany, Alfred Krupp erected a Bessemer plant at Essen which first came into operation in 1862. The Bochum Works had four three-ton converters; the Hoerde Company, near Dortmund, had two converters; a steelworks in Dusseldorf was completed with two converters. In 1863, a Bessemer converter was set up at Turroch, in Styria. In fact, in the 1860's, the Habsburg Government was one of the bodies which made the fullest use of the process, with very good results. What was especially interesting about the production of steel at Neuberg, in the province of Styria, was that the metal was run directly from the blast furnaces into the converters.(78) Speaking as late as 1875 a contemporary observer remarked that as far as he knew the running of metal direct from the blast furnace into the converters had not been put into practice in

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(77) J.I.S.I., ii, 1889, p. 24.

(78) A.S. Hewitt's Report on the Universal Exposition at Paris, 1867, to the United States Government.

Great Britain.(79) It was so in Austria, Sweden, Belgium, and Germany, and in 1867 Terre Noire, in France, had employed the direct run from the furnace, followed by the Creusot works. In the discussion which followed Deby's paper to the Iron and Steel Institute it was, indeed, confirmed that the direct process was not used in Britain - at a Barrow meeting of the Institute "it was said on the highest authority, that it could never succeed"(80) - but Edward Williams, from the Cleveland district, hoped that the process would soon become widespread there. One difficulty would be what to do "with the iron made between Saturday at mid-day and Monday morning". No doubt, as at Terre Noire, such iron would have to be cast into pigs and remelted.

The spread of the Bessemer process to the United States was largely due to the efforts of Alexander Lyman Holley, although it was Hewitt who built the first converter (on an experimental basis) in that country. (81) By 1866, a number of steelworks were in operation, one of them being the plant at the Pennsylvania Steel Company designed by Bessemer; the Manchester firm of Galloway and Sons had made the converters and the hammers by Thwaites and Carbutt of Bradford.(82) American steel plant was small, with nothing bigger than the five-ton converters of the firm belonging to Messrs. Winslow, Griswold and Holley at Troy (N.Y.). In 1868, when the 21 firms in the United Kingdom were producing 110,000 tons of Bessemer steel the American industry had a total output of 8,500 tons. Over the next twelve years, however, the latter industry greatly expanded, mainly to meet the growing market for steel rails which had been stimulated originally by salesmen of British steelworks.(83)

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(79) Julien Deby, The Manufacture of Bessemer Steel in Belgium, J.I.S.I., 1875, p. 195.

(80) Ibid, p. 205.

(81) W.F. Durfee, The Manufacture of Steel, Popular Science Monthly, 39, Oct. 1891, pp. 729-749, quoted by Peter Temin, Iron and Steel in Nineteenth Century America.

(82) H. Bessemer, op cit, p. 339.

(83) H.N. Casson, The Romance of Steel, 1907, p. 24, quoted by P. Temin, op cit, p. 130

Holley was the outstanding figure of the American steel industry in this period of growth; he held frequent meetings with John Fritz (Bethlehem Iron Company), George Fritz (Cambria Works), R.W. Hunt (Troy Works) and W. Jones (Edgar-Thomson Works, Carnegie's plant). A series of confidential reports passed amongst these men in which the many aspects of steel production were analysed, especially with the question of large makes uppermost. Of the eleven Bessemer plants in operation by 1880, Holley had designed six. He was responsible for at least two major developments; the first of these - the so-called "American" or "Holley's floor plan" - saw the converters raised high off the ground. However, Lowthian Bell was most impressed by Holley's "duplicate bottom", which was aimed at solving the problems encountered in the Bessemer process arising from the lack of durability of the tuyeres and the refractory bottom. Both tuyeres and bottom might last only for five to ten heats and, because standard American practice aimed at 30 heats in 24 hours out of one pair of converters, it was necessary "to put in and dry three and frequently four sets of tuyeres during the day". General practice in the United Kingdom (and on the Continent) entailed waiting for the vessel to cool sufficiently for a workman to enter it and do the necessary repairs. This would take some hours and then a further half day for the new bottom to be thoroughly dried. Holley experimented with duplicate bottoms - an idea first conceived by Bessemer himself - and gradually overcame all the difficulties. By 1874, he could have the old bottom out and a new one in in under one hour - at no extra cost and, naturally, with a tremendous saving in "lost" production. With improvements such as these, the Americans were, indeed, able to increase their production; in 1878, when 21 United Kingdom works were producing 800,000 tons of Bessemer steel, ten active American firms made 650,000 tons. Fortunately, some of the leading English firms decided to follow the American lead, foremost among them being Snelus at the West Cumberland Works, Bolckow Vaughan's and Brown, Bayley and Dixon's.

Both the American and British industries clearly remained some way behind leading Continental firms with regard to the direct process. Once again, Bessemer had thought of the "direct metal" plan but had not worked it for the very good reason that at his Sheffield works he had no blast furnace. Furthermore, "English" cupola practice came to accept the need to mix pigs of a known quality in order to obtain a uniform charge for the converter. Whilst the Continental industries had all taken the direct process "beyond the experimental stage"(84), the Barrow Works (Sir James Ramsden and J.T. Smith) believed that "it was a very doubtful undertaking". Fortunately, this attitude was slowly changed, especially when Bell gave his blessing to those "economies introduced on the Continent". For their part, the Americans introduced the use of an "intermediate ladle" between the cupolas and the converters:

"The plan in all the works of America was to melt in a cupola continuously, and then to run the iron into a ladle, which was balanced, and held from 10 to 12 tons. From that the 6-ton charge was run direct into the converter".(85)

John Fritz, at the Bethlehem works, erected a 30-ton ladle to receive blast furnace metal, to obtain a good mixture, and hold it in readiness for the converter; it was the first "mixer".(86)

Throughout the 1880's, the Americans continued to increase their levels of production from the acid Bessemer process until, in the early 1890's, American Bessemer practice was characterised by its "large output and its low initial silicon and initial temperature".(87) Crucial to the rapid practice of the Americans were factors typically American in

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(84) J.I.S.I., 1874, p. 356.

(85) *Ibid*, p. 362.

(86) D. Burn, *op cit*, p. 50.

(87) J.I.S.I., 1890, ii, p. 95.

concept - "powerful machinery, efficient organisation, and extreme specialisation and subdivision of labour, which can be profitable only when the output is large". By 1890, in fact, some American works were capable of achieving colossal production totals: one works, with two ten-ton vessels, had raised its annual production level from 123,303 to 318,635 tons in ten years.(88) One of the major British criticisms of the rapid American practice was that it did not produce a cheaper end product; in fact, it was suggested, it resulted in tremendous losses to both men and machinery. For their part, the Americans refuted the charge of excessive wear to the machinery. It was pointed out that some of the original equipment in the earliest Bessemer works - of the 1864 to 69 period - was still in use twenty or thirty years later. The items of machinery which had been replaced were not necessarily worn out but were, indeed, never intended to do the work which would be demanded of them in new conditions:

"In this day of rapid mechanical progress, it must often happen that machinery becomes antiquated long before it is worn out".(89)

A further criticism made of the Americans, sometimes by members of their own industry - was that they sacrificed quality for quantity:

"The desire for tonnage, tonnage, nothing but tonnage, by both manager and men, leads to slovenly , careless work".(90)

Naturally , this was hotly denied by those engaged in the pursuit of large makes; it was argued that the rapidity of the blow itself did not "injure the quality of the metal" and neither did the shortening of the intervals between blows.

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(88) Ibid, p. 97.

(89) Ibid, p. 109.

(90) Ibid, p. 149.

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Enoch James, "formerly of Dowlais, and General Manager of the Patent Shaft and Axletree Company, Wednesbury", was the member of the BITC which drew up the 1902 report on the American industry to look at the steel sector. His findings clearly show the continued growth which the American industry experienced in the last decade of the nineteenth century was based on the principles developed in the 1870's and 80's.(91) The size of the plant, together with the speed of operations, were the features of American practice which most impressed James. The four Bessemer works which had been started from new after the 1890 visit of the Iron and Steel Institute to America - Sparrows Point, Duquesne, Lorain, and Youngstown - were superbly laid out with "more room and better railway facilities to suit the improved methods of working". The Jones metal mixer, which had only just been introduced in 1890, was found in 1901 at all the works visited. The mixers were of 200, 250 and even 300 tons capacity; the molten iron was conveyed in ladles from the blast furnaces carried by electric-powered overhead travelling cranes. The mixers themselves were mounted on rollers and could be tilted.(92) Further improvements noted by James included the casting of ingots upon cars, and stripping them outside of the converter house. They had first been introduced by the Edgar-Thomson works in 1890, and by employing this method of casting, the Americans had done away with "the difficulties attending pit casting in England". James was convinced that the constant "attention to weak points and the readiness with which appliances are provided to meet new methods" were the most admirable features of American practice. This had often meant expensive and extensive reconstruction of existing plant:

"... at one of the best known and most successful Bessemer shops it was stated that the whole plant had been re-constructed four times

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(91) BITC Report, 1902, pp. 510 - 519.

(92) Ibid, p. 514.



during the last 25 years, down to the very foundations, and this, too, under the supervision of the same engineer".

Because of their "immense command of money", American engineers had been able to construct Bessemer shops in which each section was adequately suited for the work-load expected of it. James gave a good example to draw a comparison with general English practice:

"Take for example the number of converters employed. At two works only, those of Cambria and Edgar-Thomson Works, were four converters used. Three were in operation at the same time, and one was undergoing repairs when necessary. The blowing power provided is sufficient to deal with three casts at the same time, and two casts were constantly going together. At one works in England having five converters in use, the blowing power is not sufficient to blow more than one cast at a time. The proportions between converters and blowing engines are clearly in error here. This is not a solitary case, for at some other English works the blowing power is not capable of blowing two casts at once".

It was James' undoubted opinion that the Americans made certain that no section or department of their Bessemer plant was asked to do more work than it was adequately equipped to do.

In 1856, the year Bessemer spoke at the Cheltenham meeting, Frederick Siemens (1826 - 1904) obtained a patent for his method of heat-regeneration. Together with his brother Charles, later Sir Charles William Siemens (1823 - 1883), he made progressive research which led to their development of the regenerative gas furnace. So successful had they been that in 1861 Charles Siemens proposed that he apply the furnace to the manufacture of steel in the open hearth. By progressing from the use of solid fuel to the conversion of solid fuel into gas in a gas-producer entirely separate from the furnace, Siemens was able to use a low-grade coal in

his experimental open-hearth plant which he erected in Birmingham in 1865, but it was not until 1867 that the initial difficulties were overcome. Temperatures of about 1650 degrees C in the hearth were possible. At the request of Pierre Martin and his father, Siemens' engineers had built a regenerative furnace at the Martins' small steelworks at Sireuil, near Angouleme, and by adding scrap metal to the bath of molten iron steel was produced. Between the Siemens' and Martins' experiments, therefore, a steel-making process had come into being which had much to offer the manufacturer:

"The possibility of treating large quantities of metal at a very high temperature and of keeping it molten throughout the process, combined with the economic advantage of using scrap-iron and cheap low-grade coal, ensured the success of the open-hearth process"(93).

The two sides made a contract in 1867 which laid the foundations of the future success which Schubert speaks of. By 1873, the United Kingdom alone produced 77,500 tons of open-hearth steel and, in 1882, 354 open-hearth furnaces had been erected throughout the world producing 1,442,000 tons.

However, open-hearth production in the United Kingdom tended to advance very slowly in the 1870's, largely because of the doubt felt by producers over costs. James Riley, formerly of the Siemens Steel Works at Landore, admitted in 1884 that the Landore plant could not then compete with the Bessemer works in the manufacture of steel rails - the only large market for open-hearth steel. It was a widely held view that Siemens had simply presented the industry with the means of producing "Bessemer metal" by "an entirely different process".(94) As yet, few believed that the open-hearth process resulted in a superior metal, despite the added scope

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(93) Schubert, loc cit, p. 59.

(94) J.I.S.I., 1875, p. 27; J.I.S.I., ii, 1884, p. 443.

for quality control over the Bessemer process.

About the time when the open-hearth industry was languishing in Britain, progress was being achieved in France. Following on the work of the Martins' at Sireuil, three metallurgists at the Terre Noire, St. Etienne (Euverte, Gautier and Pourcel), sought ways of producing high-quality steels. They achieved their aim by increasing the percentage of manganese to their ferro-manganese compound to 75+ - manganese had long been added to both Bessemer and Siemens processes in the form of spiegel-eisen (a compound of iron and manganese), but in such cases the percentage varied between 10 and 20. In fact, the French metallurgists were improving upon a British invention, but one which had not been a commercial success initially. What brought the French achievements firmly before the eyes of British producers was the fact that the English Director of Naval Construction, Nathaniel Barnaby, was much impressed by the French use of their mild steel for ship and boiler plates. On his return from France in 1875, Barnaby asked if any British manufacturers could make a similar product. There were only two immediate takers, the Bolton Steelworks (Bessemer) and the Landore open-hearth plant. Riley admitted in 1884 that it was the French invention which enabled the Landore works to recover from its "miserable existence". By the end of the 70's, in fact, the Terre Noire method of producing "extremely soft steel" was proving beneficial to a number of works in both the north of England and Scotland.(95) The Steel Company of Scotland was, perhaps, the second company using the open-hearth process to obtain Admiralty orders for "plates for some Government gun-boats".(96) Riley had gone there in 1878 from South Wales and his presence in the Glasgow area coincided with a considerable expansion there of the open-hearth process. Rail-

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(95) J.I.S.I., 1876, p. 47.

(96) Ibid, and J.I.S.I., 1885, ii, pp. 399 - 401.

manufacture was largely abandoned, to be replaced by "the production of boiler and ship plates, with angles, bars, etc." Siemens himself paid tribute to the "new material" in 1878, no doubt relieved that at long last his process for producing steel was at least as cheap as the Bessemer process.

The first people to try the open-hearth process in the United States were Cooper and Hewitt. They built an open-hearth furnace at Trenton in 1868, but it was not successful. Present as an assistant at this experiment was S.T. Wellman, "who played a role in the introduction of the open-hearth process similar to that played by John Fritz in the rail mill and Holley in the Bessemer steel mill". (97) Wellman was determined to overcome two problems: the maintenance of the furnace in the face of the high heat attained and the cost of labour for charging.

Both the Bessemer converter and the open-hearth furnace were, of course, heavily reliant upon high quality ores; the former, with its acid lining formed of ganister, prevented the elimination of phosphorus, whilst the silica brick used in the construction of the walls, roof, hearth and posts, prevented the removal of sulphur and phosphorus in the open-hearth furnace. It was not long before interested parties were engaged in finding a way to eliminate "this objectionable element" (phosphorus)(98), although it must be admitted that many British attempts were half-hearted. (99) G.J. Snelus, of the Dowlais Ironworks and then of the West

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(97) Peter Temin, *op cit*, p. 139.

(98) T. Turner, *op cit*, p. 47.

(99) Britain was less affected by the shortcomings of the two steelmaking processes than some Continental countries; her favourable resource position (the availability of hematite ores in the Barrow district together with the near-coastal situations on the Tees and South Wales to receive Swedish and Spanish ores respectively), especially in comparison with the German industry, enabled her to establish a heavy lead in the production of acid steel.

Cumberland Works, perhaps, came nearest to identifying and solving the problem prior to Sydney Gilchrist Thomas. He showed that the retention of phosphorus was "intimately related to the slag":

"when the slag is highly basic, as in puddling, the phosphorus goes into the slag. He substituted dolomite bricks for the ganister lining, and proved that steel could be made from iron containing 2 per cent phosphorus, and the phosphorus reduced to 0.1 per cent ..." (100)

Although Snelus did, in fact, line a small Bessemer converter with lime and produce a hundredweight or more of dephosphorised iron from Cleveland pig, he did not publish the results. However, he did take out a patent for the basic process in 1872. Several French metallurgists and iron-masters, including Professor Jordan, believed that as early as 1869 a Parisian engineer had come near to a solution using a basic lining but that the Franco-German war had interrupted his experiments. (101) When, in 1875, Thomas offered a paper to the Iron and Steel Institute on the subject, it was, in fact, refused. Thomas had to wait another three years before he obtained a brief opportunity to present his ideas to the Institute during the discussion which followed Bell's paper on the phosphorus problem. It must go almost without saying that Bell was dubious about the Thomas proposals; he himself had met with considerable encouragement in experiments with molten cast iron and fluid oxide of iron at comparatively low temperatures. (102) This so-called "washing" process was adopted by Krupp at Essen, for the partial dephosphorisation of pig iron before using it for other purposes.

Thomas was promised the opportunity to present a paper of his own at the next meeting of the Institute which would be held in Paris. Again, he was to be disappointed because priority was accorded to foreign papers

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(100) A.H. Hiorns, The Basic Bessemer Process, paper read to the Iron and Steel Institute's Scientific Society, 12/12/83.

(101) J.I.S.I., 1889, ii, p. 38.

(102) J.I.S.I., 1878, i, p. 17.

and there was no time for the basic process. Windsor Richards of Bolckow Vaughan, however, had not shared Lowthian Bell's scepticism, and he had offered to give Thomas' ideas a try-out on a much larger scale than hitherto.(103) As a result, when Thomas did address the Institute in 1879 both technical and commercial success seemed assured. Assisted by his cousin, Percy Gilchrist, Thomas had succeeded in eliminating phosphorus in the process of making steel. The phosphorus in the pig iron, which was found in the converter in the form of phosphoric acid, was brought into contact with limestone (a cheap basic material) with which it combined to form a slag easily separable from the steel. The lining of the converter was particularly vulnerable but the calcined dolomite suggested by Thomas would have a longer life than anything used previously.(104) Nevertheless, the basic process as suggested by Thomas, would be more expensive than the acid process. The great redeeming factor was that the Thomas process could use the cheaper phosphoric pig and relieve steel-makers from having to rely on the very expensive hematite. A valuable agricultural fertilizer could be processed from the lime-stone slag as an added incentive. Richards, formerly of Ebbw Vale,

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(103) Experiments had been carried out at Blaenavon, whence Thomas' young cousin, Percy Gilchrist, had gone as a chemist to work under the management of E.P. Martin. Inevitably, they had to be on a small scale, the quantities used varying between six pounds and six hundredweights, Turner, op cit, p. 49.

(104) The lining was composed of well-burned or "shrunk" lime, made from dolomite or magnesium limestone, which was firmly ground and mixed with dry tar, as suggested by E. Riley, so as to allow of being pressed into bricks which were afterwards baked, or of being rammed, so as to form a lining to the converter, Ibid.

but now manager of Bolckow Vaughan and one of the most progressive men in the Cleveland district, had installed a Bessemer plant in the early 1870's and in 1874 had begun work on the large Eston plant. It was no surprise, therefore, that he should have taken an interest in the basic process and become "one of the earliest pioneers in Britain".(105) On 4 April 1879, he gave a public demonstration of the process at Bolckow Vaughan. By November of that year, Richards was obtaining very satisfactory results in the manufacture of steel from Cleveland pig iron. He later told members of the Institute that his firm was putting in some big converters at Eston especially erected for the Thomas-Gilchrist process because "in using the old converters ... the output of ingots was much too small, and it was evident that a large rolling-mill plant such as those at Eston, could not be kept at half work".(106) Middlesbrough was soon "besieged by an army of metallurgists from Germany, Belgium, France and the United States", all of whom were anxious to have an opportunity of seeing the process in operation.(107) The firm of Hoerde, Westphalia, took advantage of Richards' invitation to attend the Bolckow Vaughan demonstration and in return they made their experiments open to representatives of English firms. Sheffield firms took advantage of this offer.(108) R. Pink, manager of the Hoerde Works, was able to experiment for a time in a small plant of two 3-ton converters because the company was working at half pressure due to the depressed state of the German industry throughout much of 1879. Pink made "a most reliable and cheap steel" from the "worst classes of pig iron". In September, 1879, he got the "first rail manufactured under the Thomas patent in Germany".

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(105) J.I.S.I., 1880, i, p. 79-80.

(106) *Ibid*, p. 102.

(107) Turner, *op cit*, p. 49.

(108) J.I.S.I., 1880, i, p. 80.

Undoubtedly, the basic process sharply altered the comparative advantages against Britain as a manufacturer of steel, and not least because it meant that Britain had lost her superior resource position.(109) Followed so quickly afterwards by the discovery of the Mesabi ores, which inevitably led to a decline in U.S. demand for British steel, the British industry was now faced with an entirely changed situation. Just as the huge ore supplies helped to encourage innovation in the United States industry, so now the basic process on the Continent, based upon the phosphorus-rich ore in Lorraine and Sweden, brought about what almost amounted to a revolution in Europe's steel industry. Not least to change was the plant used in the production of steel. Whilst the British industry "tinkered and improvised", the Continental steelmakers, "stimulated by necessity .... worked at the basic process with a scientific will; they achieved and maintained a proper mix and produced a metal of good, uniform quality". (110) As in the United States, the major Continental producers, and notably the Germans, sought after the large plant, from the smelting stage to later stages of manufacture. German equipment, which was formerly much smaller than that in the United Kingdom, rapidly outpaced the latter in both size and output. Furthermore,

Annual Output of Steel Plant, Britain and Germany.

	<u>Blast Furnaces</u>		<u>Bessemer Converters</u>
	1870	1910	1901
Britain	8,700	30,000	21,750
Germany	5,000	49,000	34,000

the Germans, as, indeed, the Americans as well, erected fully-integrated works, i.e. the production unit consisted of blast furnaces, steel plant and rolling mills. The very size of American and German plant made imperative extensive mechanisation; the huge quantities of ore and fuel for the blast furnace, the conveying of large amounts of hot

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(109) In fact, inertia on the part of the personnel of the British industry, leading to a failure fully to exploit the Northants ore, only exacerbated the situation.

(110) D.S. Landes, op cit, p. 263.



metal to the steel plant - both called for more than "the traditional winch and counterweight systems or even human brawn and hand shovels". Originally, the open-hearth process, acid or basic, had been attractive for the small producer even without a <sup>blast</sup> furnace or two on site, and, in fact, this remained very much the case in the United Kingdom.(111)

The Americans, followed by the Germans, changed this with the introduction of their giant, tiltable furnaces of 100 to 300 tons capacity; mechanical means of charging such furnaces were a must and S.T. Wellman came up with the electrically-driven charging machine. By the early 1900's, when the open-hearth furnaces in the United States were still of the 40 to 50-ton variety, Enoch James remarked that that Americans were able to get "14, 15 and 16 heats" from their furnaces "with less physical exertion on the part of the workmen engaged than would be necessary in England for half the number of casts".(112)

Characteristically, the British industry hesitated over the Wellman machine. It was generally recognised that "human brawn" would have to be replaced by machinery, but there was too much suspicion of electricity amongst British steel-makers:

"... the one thing he should hesitate about was the application of electricity ... he did not think that this country had yet got such a strong confidence in the use of electrical apparatus in steelworks as that they might venture readily ... to spend the large sums of money necessary for the installation, not of one machine, but, in large works, of two, three or four of those machines".(113)

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(111) D. Burn, op cit, pp 238 - 40.

(112) BITC report, 1902, p. 528.

(113) J. Riley, J.I.S.I., 1897, p. 104.

Over the next few years, a few steelworks in the United Kingdom overcame both their conservatism and their site problems(114) and installed charging machines. Bolckow Vaughan, Cargo Fleet, Palmer's and Sheepbridge installed one or two charging machines each, whilst the Parkgate Works, Yorkshire, actually installed a Wellman machine. The Cleveland firms had generally opted for a Tomkins machine for the charging of their furnaces.

Against the background of tremendous change and growth abroad, the Black Country established a steel industry on a firmer footing than hitherto. Reference has already been made to the experiments in basic steel production carried out by Alfred Hickman and his decision to go into steel production with the setting up of the Staffordshire Steel and Iron Ingot Company in 1883. Although small and fairly traditional in concept, the lay-out of Hickman's Bessemer plant was very sound. Three Bessemer converters of five tons capacity were arranged in a row at 25 feet centres and 15 feet above ground level (the so-called "American" or "Holley's" floor plan). Each converter was fitted with an hydraulic lift to enable the worn-out vessels to be replaced by relined ones; besides, Hickman had provided sufficient blowing power to deal with two casts at any one time - there were two pairs of blowing engines to give an air blast of 15 lbs. per square inch. Cold or molten metal could be used in the works, the former being melted in three large cupolas from which it was tapped out into a travelling ladle which was raised by a 20 ton hydraulic lift to the Bessemer platform. The blown metal was cast into ingot moulds contained in a casting pit from which the ingots were removed by five cranes. To overcome the variable silicon content of the pig iron used at Spring Vale, Hickman introduced a two-stage process of working typical of duplexing processes used in later

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(114) E.W. Richards admitted in 1897, when talking of the Wellman charging machine, that he sometimes wished that he "could pull down the whole works at Bolckow's and start afresh"; he envied the space which the Americans had at their works(J.I.S.I., 1897, p. 106)

years.(115) His work was, in fact, contemporary (but separate) with that of Professor F. Kupelwieser at the Hollerich Works in Luxembourg.

In 1887, Hickman decided to introduce the open-hearth steel process to the Black Country for the making of basic steel. A little surprisingly, he chose a Batho furnace, a modification of the Siemens furnace with the regenerators for preheating the air and gas placed outside the furnace and quite separate from it. By keeping the furnace and regenerators apart it was hoped that the furnace would cost less to erect since little or no excavation was needed. Darby, at the Brymbo Works, had taken a great interest in the Batho furnace, but, in fact, it was not generally used by steelmakers and Hickman replaced his later in the century. Hickman's decision to install open-hearth furnaces was no doubt taken because of the advantages which that process had over the Bessemer converter, especially the cost-factor where comparatively small makes were concerned.(116) Furthermore, the use of scrap in the charges meant that both phosphorus and silicon could be diluted down as necessary, the latter without the need for further desiliconising treatment.

D. Burn has suggested that the "bigger malleable ironmakers, where their puddling business was threatened, could with little expense turn to the new business (open-hearth steel production), utilise their old rolling plant, and market steel with the goodwill established in the iron business".(117) This, clearly, was what happened at the Earl of Dudley's Round Oak Works in 1890; by the end of that year, one Siemens-Martin furnace (capacity 3,000 tons per year) was in operation. Three years later there were three 17-ton open-hearth furnaces at Round Oak.(118)

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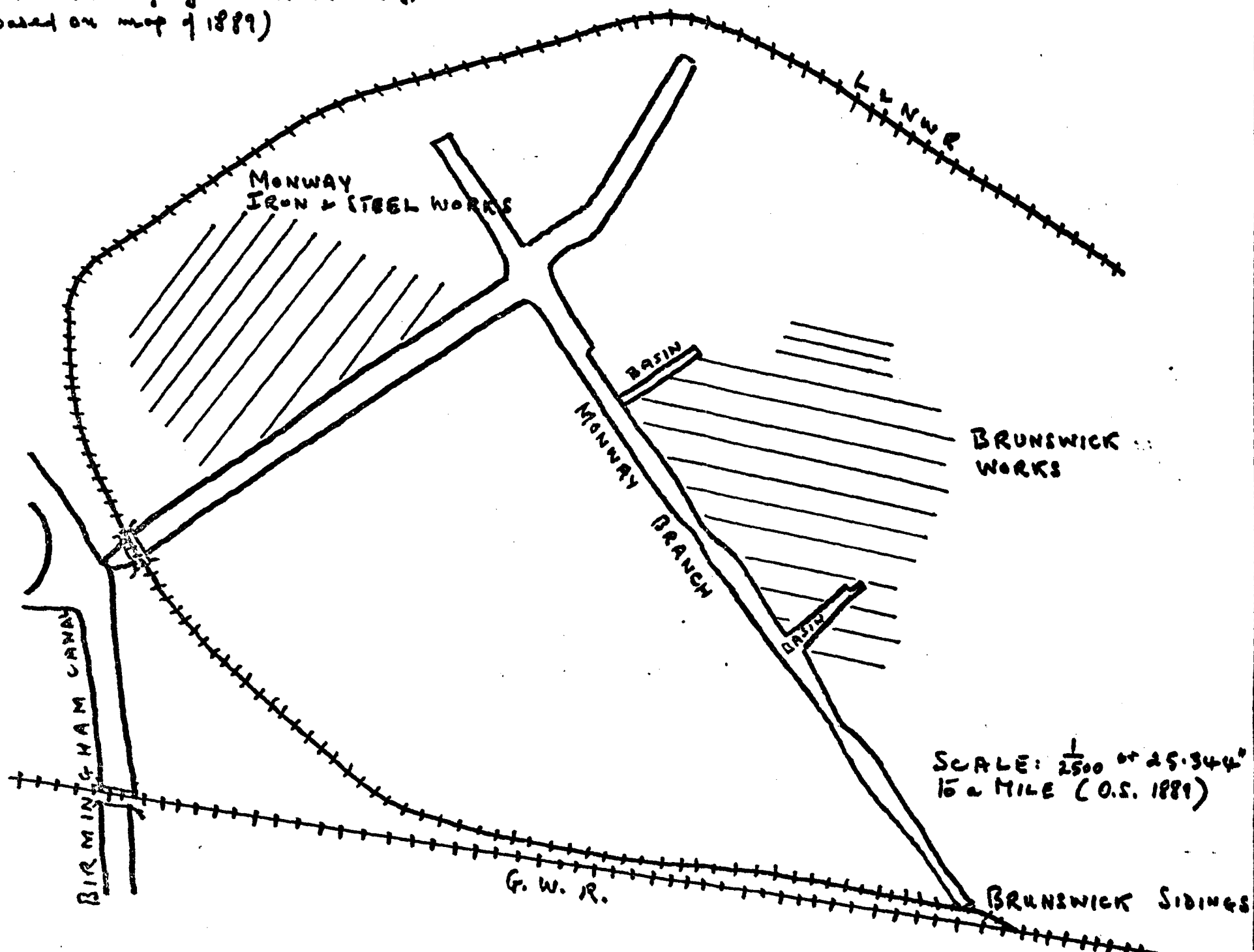
(115) For a fuller technical account, see G.R. Morton and M. Le Guillou, loc cit, pp. 14 - 16.

(116) D. Burn, op cit, p. 239. Also, views of Le Neve Foster, Proc. S. Staffs., 1898-99, pp. 39-40 and 1901-2, p. 101.

(117) D. Burn, op cit, p. 239.

(118) Proc. S. Staffs., 1890-91, pp. 22-26, paper read by R. Smith Casson.

WORKS belonging to Patent Shaft  
(based on map of 1889)



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In Alexander Smith's valuation of the 'Round Oak Steel Works' in 1897 he listed the existence of five twenty-ton basic open-hearth steel furnaces. His description of them was as follows:

"... W. I. Framing Cast Iron doors & Frames White Brickwork.

Regenerators underneath, mushroom reversing Valves and Flues

W. I. Stack 100 ft x 5' 10" dia Cast Iron bottom and brick base"(119)

There was no mechanical charging of the open-hearth furnaces but a "Hand Railway", supported on "Girders and Cast Iron Columns", ran to and from a "Tapping Platform". The casting pit had "massive brickwork and Cast Iron Taps with Steel Rails". Casting ladles mounted on trolleys were also in use, together with a "Loco Ingot Crane" of 12 tons capacity and two more of five and three tons respectively.

The third of the larger steel works in South Staffordshire, 'Patent Shaft', was, through the acquisition of the Old Park Works, the oldest steel producer (by either of the new methods of production) in the district. However, the acid Bessemer plant had been allowed to fall into disuse and, following some difficulties in the 1890's, a decision had been taken to concentrate steel production at the Brunswick Works. Two comparatively large open-hearth furnaces (basic-lined Siemens variety) were put down, one of 40-tons and the other of 30-tons capacity.(120)

The steel department of the Black Country iron and steel trade was, indeed, an area of considerable growth in the years after 1900, and this is reflected in the amount of improvements to steel plant which were undertaken, especially at Round Oak and Spring Vale. In 1904, the steel plant at Round Oak was "thoroughly modernised"(121), the Bertrand-Thiel process was installed, an American charging machine erected and a

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(119) The entry is as it is written in the valuation.

(120) Documents in possession of the present company, 1969.

(121) Colliery Guardian, 23/9/04.

metal mixer brought into use capable of containing 200 tons of molten iron.(122) At Spring Vale, similar attention was being given towards the reduction of production costs; experiments were continued for a number of years - 1905 - 1909 - to bring the molten iron 'direct' from the blast furnaces to both the basic Bessemer converters and the Siemens furnaces. It would appear that Hickman could not improve upon the "hot metal mixer" method:

"Practically all iron is taken molten from the Blast Furnaces to the Mixers, one small 150 tons capacity and one of 500 tons. These are both active , being fired with Producer Gas, and considerable work is done in them".(123)

Whilst continuing with their three 12-ton converters, the Spring Vale works, in 1911, began a new building programme of larger open-hearth furnaces for the production of mild steel.(124) The first furnace to be erected was one of 40-tons capacity, and this was joined a few years later by one of 150-tons capacity. In 1911, Spring Vale was producing 3,500 tons of steel weekly, whilst Round Oak (8 furnaces) and Patent Shaft and Axletree Company (10 furnaces) were producing 1,500 and 1,500 to 2,000 tons respectively.(125) As previously mentioned, the Weldless Steel Tube Company of Birmingham also began open-hearth steel production in 1911 - 12.(126)

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(122) Bertrand and Thiel, at Kladno in Austria-Hungary, had used two steel refining furnaces, the charge being partially refined in the first and then tapped into the second for finishing. Only Round Oak and the Brymbo works gave the process a real try-out in the United Kingdom, although it was a process similar to that earlier tried at Spring Vale.

(123) Report by C.G. Atha on Alfred Hickman Limited, 16/4/1920.

(124) Colliery Guardian, 22/11/11.

(125) Ibid.

(126) Colliery Guardian, 3/11/11.

### Rolling and Sheet Mill Equipment.

Developments in mill practice after 1870 were very greatly influenced by the change-over from iron to steel, with the earlier initiatives being almost wholly associated with the rolling of steel rails. The Black Country was not involved in these developments, although it is clear that representatives of the local iron trade were aware, if not completely in favour of, the changes being brought about. Two countries stood out in being 'pioneers' in mill innovations - the United States and Belgium.(127) Almost inevitably, the American industry had gone after the 'large make' machinery and equipment. Whilst the United Kingdom industry, especially Menelaus at Dowlais, had achieved much greater production with the reversing mill, the Americans opted for the three-high rolling mill.(128) This method speeded up production, and was particularly suited for the American market conditions.(129) As Lowthian

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(127) The United Kingdom's participation in this field must not be underestimated. The three-high mill, the 'Universal' mill and the continuous mill all had their supporters in this country, despite the fact that the structure of the industry and market conditions might not have been as favourable as in the United States or on the Continent. See D. Burn, op cit, pp. 58 - 61 and 192 - 198.

(128) The use of a third roller placed above the top roller of the first pair was not a new idea; it was employed by John Wilkinson (Gale, op cit, pp. 53 -4) and Thomas Butler, the noted Yorkshire ironmaster, had observed in 1815 that the plates passed through "three grooved rollers fixed upon each other" at the 'Bilston New Mill' of the Gibbons' brothers. However, John Fritz at Pittsburgh had introduced the three-high mill principle in 1857 for a 'continuous' process of rolling. This was only possible because of the efficiency of the steam engines then in use .

(129) D. Burn, op cit, p.58.

Bell saw on his visit to the United States in 1874, best mill practice meant that ingots were "reduced to the size first for the finishing mill, without a man ever touching them".(130) One man operating a "small double cylinder engine" sets the rollers in motion; another, "by means of hydraulic pressure", manipulates the "feeding tables" and traversing frames along which the ingots can pass backwards and forwards.

The Belgians, in the 1870's, originally favoured the British-type reversing mill, and before going over to the three-high mill they achieved a break-through with the "rolling in one heat" process.(131) Not surprisingly, in view of the growing Belgian competition with the Black Country industry, representatives of the latter gave a good deal of attention to developments in Belgian mill practice. In 1870, for example, a group from the local Institute of Mining Engineers had visited Belgium and had been much impressed by the "bold engineering enterprises, yet rigid economy" of the Belgian firms (notably Cockerill's of Seraing).(132) The Belgian industry's adoption of the Universal mill - the simultaneous use of both vertical and horizontal rollers - was admired by Walter Williams(133) and Lowthian Bell who, nevertheless, both took pains to emphasise that it was a Mr. Arrowsmith of Bilston who had invented that type of mill. Generally, United Kingdom opinion was not favourably disposed towards the Universal mill; it produced materials of poor quality, an aspect of the Belgian industry that Black Country spokesmen seemed at pains to emphasise.(134)

Throughout the 1880's and 90's, developments in best rolling mill practice continued in the United States, on the Continent and in the

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(130) J.I.S.I., 1875, p. 127.

(131) J.I.S.I., ii, 1877, p. 149.

(132) I.C.T.R., 6/7/70.

(133) H.H. Creed and W. Williams, Handicraftsmen and Capitalists, 1867, (reprinted from The Times), p. 63.

(134) See views of W. Farnworth, manager of E.P & W. Baldwin, J.I.S.I., 1875, pp. 247 - 51.



United Kingdom. American practice was characterised, typically, by the large scale of its operations. Economy of production was achieved through the elimination of hand labour, although this entailed heavy capital expenditure on complicated machinery. Commenting in 1890 on the large makes of the "great mills of the country", Bell wrote:

"These results are largely contributed to by the complete and ingenious appliances for handling the bar, by rolling off in one heat, by rolling the bar in several instead of one pair of rolls in order to have a number under treatment at the same time, by using multiple saws for cutting up the bar, by the use of cambering machines to facilitate straightening, and by speed of machinery".(135)

Bell was most impressed with American rolling mill practice, although he was a little concerned over the amount of machinery in use in some of the mills. Maintenance costs could be high and, indeed, there had been a great need for engineering skills of the highest order to manufacture the machinery in the first place. Morgan's adaption of Bedson's "continuous mill" (originally for wire-rod rolling) for the manufacture of steel rods, bars, strip and billets is a good illustration of this point. The Americans spared no expense to ensure that their large mills were constantly at work(136); any stoppage in that department would mean that the Bessemer shop would also have to stop "for cold steel is not acceptable, nor could it be dealt with under existing conditions without dislocating all the subsequent stages of the manufacture".(137) The 1895 BITA report on conditions in Germany and Belgium brought home to the Black Country ironmasters many of the excellent rolling mill practices in those two countries. Steel products, of the highest quality, were

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(135) J.I.S.I., 1890, Special Volume, pp. 281 et seq.

(136) BITC Report, 1902, p. 548.

(137) Ibid, p. 551.

rolled in both countries. It would appear, however, that neither of these two countries quite matched the progress being made in the United States, progress, in fact, which continued right up to the First World War.(138)

Rolling mills in the Black Country had, of course, produced a wide variety of articles throughout the nineteenth century and, in their own way, had proved to be highly efficient. However, in the period which saw the decline of wrought iron and the growing supremacy of steel, the rolling mill department of the Black Country tended to stagnate. Exceptions to this general trend once again were to be found amongst the steelmakers and among one or two of the larger producers in the finishing trades. The key-point with the steel works, and especially Alfred Hickman's Spring Vale plant, was that they were experiencing a period of growth which warranted the installation of new rolling mills. At the time when Hickman first engaged in the production of steel he adapted his existing mills to the new material and only a small amount of new equipment was used. Even then it was efficiently and economically operated. Ingots were removed from the casting pit by five cranes; they were then reduced to blooms in a cogging mill and the billets were then re-rolled in a finishing mill with two stands of rolls driven by a pair of horizontal engines. At Round Oak, in the early 1890's a new rolling mill and ancillary equipment was installed to deal with the basic open-hearth steel. It included a 30-inch cogging mill, with attendant live-roller gear, vertical engines, inverted cylinder engines, together with a "massive set" of hot shears, and a 28-inch bar mill with, in addition to material similar to that above, a 25-ton overhead steam-travelling crane and an hydraulic jib crane.(139)

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(138) J.C. Carr and W. Taplin, op cit, pp. 222 - 227.

(139) Alexander Smith's Valuation of 1897.

Two developments outside of those taking place at the main steel works occurred in the 1890's. The first concerned the ill-fated New British Iron Company at Cradley Heath. In the year before it failed, the company possessed at least eight different mills, including an 8-inch guide mill, an 8-inch hoop mill, a 10-inch merchant bar mill, a 12-inch merchant bar mill, a 20-inch sheet mill, a 16-inch bar mill and a 15-inch strip and slitting mill. The New British Iron Company was, in fact, in the process of changing completely over to steel and, as part of a programme of plant installation, Jeremiah Head was commissioned to design a new cogging and shearing plant capable of dealing with ingots weighing about 20 cwt. each and measuring not more than 15 inches square at the thick end. It would be designed to roll these down to 6 x 2 inches.(140) Head's cogging mill was in the course of installation when the company crashed and it was eventually offered for sale in its unfinished condition.(141) The second development took place at the Osier Bed Works of John Lysaghts in the period 1894 - 95. Like the New British Iron Company, Lysaghts decided to install a new mill (sheet mill in this case) expressly for the purpose of working steel. The Colliery Guardian described the mill as one of "the finest steel rolling works known" and saw it "as an important step in the displacement of iron for steel for galvanising purposes".(142) Following the great amount of discussion which was held over the BITA report on Germany and Belgium, and especially the suggestion that the "English (were) being beaten by their Continental competitors" because of better machinery (amongst other things) Thomas Morris wrote to the secretary of the South Staffordshire Institute to deny this:

"Is there a plant throughout the whole of the Continent that can compare for efficiency with the new sheet-rolling mills at the Osier

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(140) Colliery Guardian, 3/3/93.

(141) W.K.V. Gale, The Black Country Iron Industry, p. 118.

(142) Colliery Guardian, 19/10/94.

Bed Works, Wolverhampton? Are there any sheet-mills either in Germany, or in Belgium, doing more work, per pair of hard rolls, than is being done in some of the despised, tumble-down sheet mills in certain parts of South Staffordshire?"(143)

Late in 1906, Sir Alfred Hickman Limited took a decision to install a large new merchant steel mill specially designed for the production of half-product bars and billets.(144) Installation of the equipment was carried out towards the end of the following year and beginning of 1908. Described as "one of the most important in England", Hickman's was the first English-designed electric reversing (30-inch) cogging and (24-inch) bar mill. The cost of the mill was put at £100,000 and would have an estimated output of 1,500 to 1,600 tons per week. With nearly all the Staffordshire ironmasters of "much importance" rolling down half-product steel into sheets, hoops, strip, etc., Hickman's new mill was assured of success. In fact, not long before his death in March 1910, Sir Alfred Hickman had made known his intentions to lay down new machinery for the rolling of plates and other descriptions of steel.(145) Almost simultaneously, Round Oak was announcing plans to increase production

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(143) Proc. S. Staffs, xi, 1895-6, p. 125.

(144) For a stage-by-stage account of the installation of this new mill, together with its effects on the Black Country steel scene, see the Colliery Guardian, 9/8/07, 8/11/07, 11/12/08, and 29/1/09.

(145) Ibid, 16/7/09. Atha's description of the rolling mill equipment at Spring Vale in 1920 was not very favourable:

"(it) consists of three Cogging Mills, each about 35". I cannot quite understand why they should have three as I should think one - a comparatively new Mill, electrically driven - could easily be made to do the work of all three and effect a considerable saving".

Nevertheless, he thought that the site was ideal for the installation of a continuous strip mill.

by providing "up to-date rolling plant". (146) Furthermore, even amongst firms engaged solely in re-rolling steel there was "a certain amount of modernisation and here and there equipment of quite advanced design for the period was introduced".(147) The Bromford Iron Company, of West Bromwich, for example, introduced in 1909 the first continuous strip mill in the Black Country - a straight-line 6-stand continuous mill driven by a steam engine of 1,100 h.p..(148)

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(146) Colliery Guardian, 10/9/09.

(147) W.K.V. Gale, The Black Country Iron Industry, p. 120. In any case, it was found that rolling mill equipment originally designed for iron resulted in a lower level of production when steel was used.

(148) The Engineer, 5/11/09.

### Chapter 3 . The Supply of Raw Materials.

"Nature", wrote Elihu Burritt in 1868, "did all she could for the ironmasters of the Black Country; indeed, everything except literally building the furnaces themselves".(1) It was, indeed, the case that the district in the first 40 years of the nineteenth century possessed abundant supplies of those raw materials necessary for the making of iron. Coal and ironstone were available and the stratification was such that very often both minerals could be obtained from the same shaft. Fireclay was also available, together with limestone and refractory sand. The very abundance of some of these materials, together with their high quality and easy accessibility, proved, to some extent, the undoing of the district. Within the Black Country, there grew up an industry which adopted wasteful practices, which tended to seek after perfection of the finished product, but which failed to develop a resourcefulness and a willingness (or ability) to adapt to changing circumstances.

#### Iron Ore Supplies.

On the occasion of the 1865 meeting of the British Association in Birmingham, a number of local people contributed to an account of the Birmingham and Midland Hardware District. Samuel Bailey wrote about "The Economic Value of Various Measures of Coal and Ironstone in the South Staffordshire Coalfield"(2), and his account of this subject has formed the basis of all future contributions.(3) Bailey divided

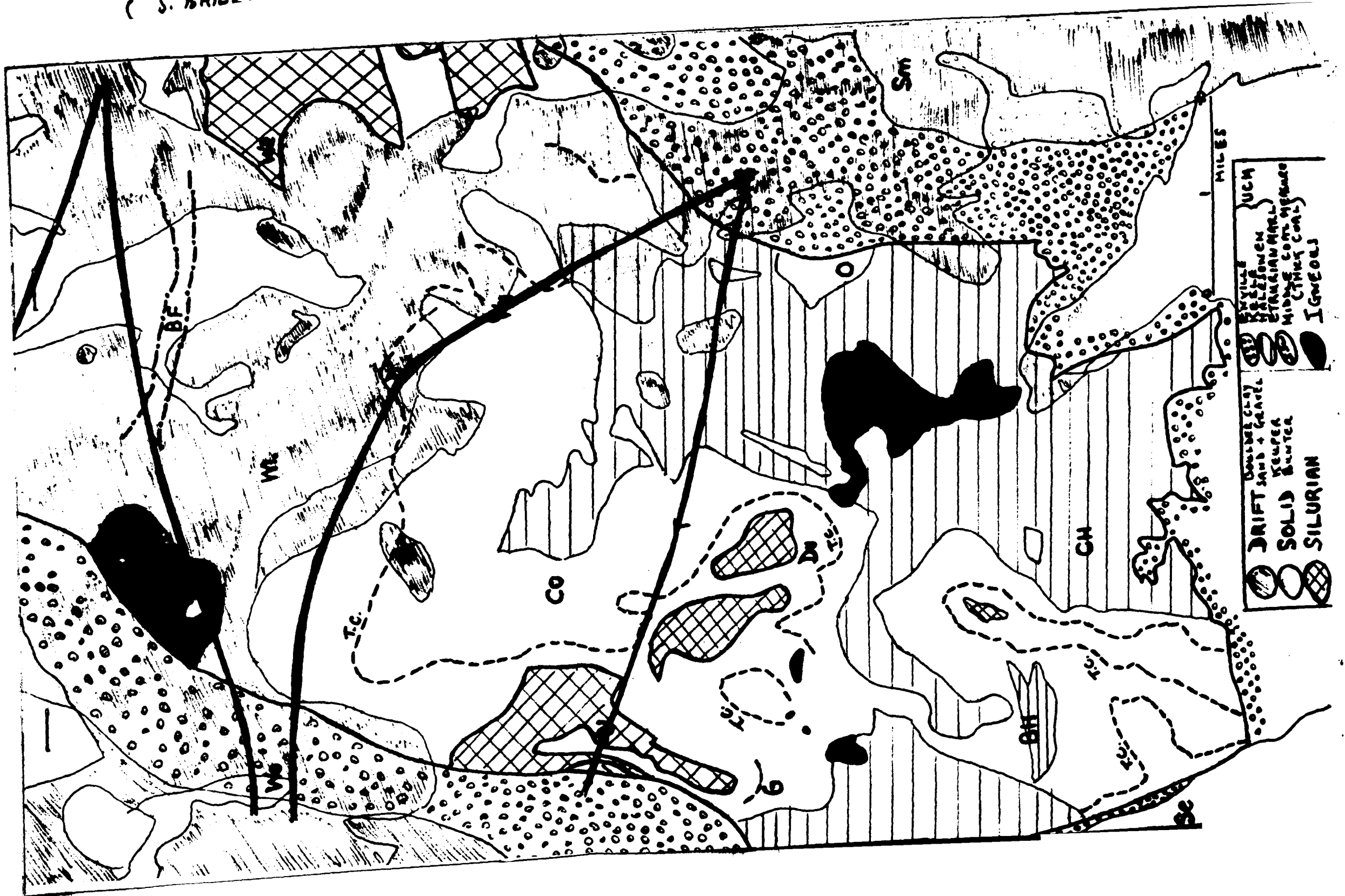
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(1) E. Burritt, Walks in the Black Country and its Green Borderland, 1868, p. 3. ;

(2) Ed. S. Timmins, Birmingham and the Midland Hardware District, 1866, pp. 27 et seq.

(3) Bailey himself relied heavily on the work of J.B. Jukes, The South Staffordshire Coalfield, in Memoirs of the Geological Survey of Great Britain, second edition, 1859.

# THE GEOLOGY OF THE BLACK COUNTRY (S. BAILEY, F.R.S.)



Map 7

the Black Country into five districts, in four of which ironstone measures - some of them extremely rich in ore - were worked. The southernmost district, lying southward of a line drawn from West Bromwich on the eastern side of the coalfield, through Tipton and Deepfields, to the western fault near Sedgley, contained both Gubbin Ironstone (46.30% iron content) and White Ironstone. Whilst the yield of ironstone was not large, when compared with later finds elsewhere in Britain and the world, it did average out at about 1,300 tons per acre per seam. It was 'computed' (4) that the ironstone raised in Lord Dudley's estate alone "totalled 200,000 tons per year". The next district, lying to the north of the first, extended by a line from West Bromwich Old Church through Wednesbury, Darlaston to the north of Bilston as far as the west fault, a little to the south of Wolverhampton. It contained Gubbin, New Mine, Fire Clay Balls, Poor Robin(s) and White Ironstone, Gubbin and Balls, and Blue Flats. The Gubbin and Balls (49.30% iron content) was the most important in this district, and was found mainly near Darlaston. The third district, lying immediately to the north of the second, extended to a line drawn from Rushall through Bloxwich into the western fault at Heath Town, and included Walsall, Bentley and Willenhall. Here were to be found the following ironstones - Brown, New Mine, Poor Robin(s), Gubbin, Blue Flats, Silver Threads and Diamonds. The Blue Flats (42.34% iron content) was probably the most important. The remaining district to possess ironstone, and the least worked in 1860, ran from a line extending from Goscote or Rushall, into the western fault, near Cannock. Here were to be found Black Gubbin and Brown ironstones.

In addition to the names of local ironstones already given - all of which were argillaceous ores - there were Brooch Binds, Pins or Penny-earth and Pennystone. The measures of ironstone were very varied.

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(4) Colliery Guardian, 27/10/99.



Brooch Binds occurred immediately beneath the Brooch coal, but they contained ironstone only to the south-west of Dudley. The Pins and Pennyearth ironstones underlay the Herring Coal, whilst the Gubbin came in below that Thick or Ten-Yard Coal and was the most widely diffused and richest ironstone beds of the district. The New Mine or White ironstone was deposited under the Heathen Coal. It was a light-coloured stone, and occurred in large modules in a bed of clay, or clunch (soft white limestone), and also in continuous bands. Penny-stone was a partial band underlying the New Mine. Fire Clay Balls occurred in large masses coated with argillaceous matter, whilst the Poor Robin(s) stone was suitably named. Gubbin and Balls ironstone was found under the Bottom Coal and the Blue Flats under the Singing Coal. The Brown Stone, found chiefly in the Bloxwich area, was "condemned as a poor worthless ore" for much of the first half of the century.(5)

When Samuel Bailey wrote his account of the ironstones of the South Staffordshire district, many of the listed varieties were already no longer available to the ironmaster. Either the beds had been exhausted, or they were simply too costly to extract (and in some cases too dangerous). Two points were very clear in the early 1860's. Firstly, gone were the days when the local Black Country blast furnace proprietor could afford to pay "20/- and 24/- per ton for ironstone".(6) The Scottish industry, based upon Neilson's hot blast, the blackband ironstone and the Lanarkshire splint coal (used raw in the blast furnace), had appeared as a formidable rival to the Black Country. Once the main bed of lias ironstone had been discovered at Eston, near Middlesbrough, in 1850, there occurred the phenomenal growth of the Cleve-

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(5) J.I.S.I., 1871, p. 20.

(6) S. Bailey, Steam Power .... in the Coal and Ironstone Mines of South Staffordshire, Paper read before the Birmingham Meeting, the North of England Institute of Mining Engineers, x, 1862, p. 29.

land district. Secondly, the South Staffordshire iron industry was consuming over 1,800,000 tons of iron ore each year, whereas, according to the estimated totals of R. Hunt, the district was producing only about 950,000 tons of ore.

The shortage of local ironstone first gave cause for concern in the 1840's(7). The Quarterly Meetings of the iron trade in Birmingham provided the opportunities for the ironmasters to voice their misgivings. It was clear that the shortage of ironstone had hit the south-western side of the district first - the dividing line being the Rowley Regis - Dudley Castle range of hills - and in the early 1840's, the Gibbons' were familiar with the problem of maintaining supplies of ore to their blast furnaces at Corbyn's Hall and Shut End. Ore was being 'imported' from the Wolverhampton and Tipton districts, and there is evidence to suggest that they were seeking mineral rights to lands well to the north-east of Wolverhampton in their search for local ironstone.(8). Gibbons' neighbours, at the Ketley Furnaces, had gone much further afield and were obtaining ore from the Furness Peninsula (through Ellesmere Port), from Froghall in North Staffordshire and from the "Bedworth Balls" seam of Warwickshire.(9) As time went on, the situation pertaining to local ore supplies steadily deteriorated. S.H. Blackwell, ironmaster of Russell's Hall, Dudley, frequently spoke and wrote on this aspect of the Black Country iron trade. "There are upwards of 20 mills or forges now standing in South Staffordshire", he wrote in June 1861, "which in all probability will never again go to work, and that the suspension of these works has not arisen in any case from want of capital or

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(7) H. Scrivenor, History of the Iron Trade, 1854, p. 299.

(8) Gibbons' Deeds Boxes, William Salt Library & C.R.O., Stafford.

(9) O.W.W.R. Committee Evidence, 1845, especially of Benjamin Best and Richard Smith.

reckless trading, but from the utter inability of obtaining cheap supplies of minerals..."(10) As Blackwell himself well knew, this was not strictly true. Ore could be obtained cheaply by this date from Northamptonshire but, as will be shown shortly, the scientific/technical knowledge of the average Black Country blast furnace proprietor was not sufficient for him to use the ore with any degree of confidence. Local ore, i.e. ore mined within the confines of the Black Country itself, had become too expensive and too costly to mine. Even where the ore was mined and consumed in the blast furnaces owned by the same firm, there was evidence to suggest that royalties were too high or that "the dead charges (were) too great per ton on the small quantity raised, and that nearly two tons ought to be raised for the sum which one ton now costs".(11) By 1871, whole areas of the Black Country were exhausted, including the once important parts of Priestfields, Bilston, Willenhall, Darlaston and Wednesbury.(12) Others, like Bloxwich, were "nearly exhausted". George Addenbrooke and T. Parkin investigated the situation in that year and reported their findings to the Iron and Steel Institute:

"The present producer of ironstones ... cannot supply more than half the demand required to keep the furnaces going in the said district".(13)

Even the poorest ores of the district, once ignored by the smelters, were estimated to last for only another ten years. In fact, exactly ten years later, Mr. Sparrow, owner of the Millfield Furnaces (and

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(10) Midland Counties Herald, June 1861, quoted by S. Bailey, loc cit, p. 27.

(11) S. Bailey, loc cit, p. 25.

(12) J.I.S.I., 1871, p. 20 et seq.

(13) Ibid, p. 22.

others), claimed that the mines of South Staffordshire were "not exhausted and worked out, but drowned out".(14) The Earl of Dudley's works were said, at this time, to be the only ones in the district still making pig iron from native ores. Certainly by the last few years of the century, the amount of ore produced locally had dried to a trickle:

Production of Ironstone in South Staffordshire.

<u>Ore</u>	<u>1895</u>	<u>1896</u>
	Tons	
Produced under Coal Mines Act	31,205	30,096
Produced from quarries under Quarries Act	2,290	2,086
Total	33,495	32,182
Price per ton in South Staffs.	10/-	9/6
Average U.K. price	-	3/7

In addition to the ores mined in South Staffordshire, John Gibbons had shown in the 1830's that the "refuse of the puddling furnaces" could be used to make a cheap pig iron.(15) However, not all the Black Country blast furnace proprietors could match Gibbons' knowledge of blast furnace practice and for a great number of years cinder pig was regarded with some suspicion and then distrust. Consequently, the tap cinder remained unwanted and therefore extremely cheap to purchase. Alfred Hickman made full use of it in the 1870's, producing a satisfactory common pig iron, made from a mixture of "Pottery, Northampton and taps". However, the whole situation changed quickly in the early 90's, when the basic steel producers realised the suitability of tap

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(14) Select Committee on Railways, 1881, M.E. 14385. Alfred Hickman told the Committee: "... the stone of the district has been worked out to a very great extent; and, moreover, the operation of the Mines Regulation Act, the limitations as regards young persons, and the hours of working, has been to increase the cost of getting the ironstone of the district (which is very thin) in which boys' labour could be used very advantageously..." M.E. 4567.

(15) W.A. Smith, "The Contribution of the Gibbons Family to Technical Development...", West Midland Studies, 4, 1970/1, p. 51.

cinder. From being 3d. per ton, or "the cost of carriage", tap cinder rose to "2/6 and cost of carriage" in May 1893; a further rise to 4/- a ton then occurred. The Birmingham correspondent of the Colliery Guardian wrote:

"The new aspect of affairs is very welcome to the trade, and no one will grudge the ironmasters their good fortune in this matter, for they have fallen upon evil times, and if the sale of tap cinder does not augment their profits, it may, at any rate, diminish their losses for the time-being".(16)

However, there were also disadvantages for the district in the rise in the price of tap cinder. With cinder pig selling at only 37/6 to 38/- per ton in the early months of 1894, blast furnace owners could not afford to pay 4/- a ton for the tap cinder.(17) Nevertheless, tap cinder did remain as a very important raw material for the local steelworks.

By the late 1850's, some 100,000 tons of high-grade ore were coming to the Black Country ironmasters from the Furness area. Because of high freight rates, the cost was high, and the ore was used only in the making of better grades of pig iron. Upwards of half the Brown Hematite (the so-called hydrate of iron) mined in the true coal-measures in the neighbourhood of Cheadle, North Staffordshire, was sent into the Black Country.(18) The North Staffordshire ore was "highly esteemed in South Staffordshire for making special classes of pig iron".(19)

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(16) Colliery Guardian, 12/5/93.

(17) In fact, in the boom in pig iron prices of a few years later, the price of cinder pig more than doubled, and the price of tap cinder reached 10/- a ton for a short time.

(18) J. Jones, loc it., p. 63.

(19) Ure's Dictionary of Arts, Manufactures and Mines, 1878, edited by R. Hunt, vol 2, p. 923.

Alfred Hickman, for example, made a very successful Hydrate Iron from a mixture containing hydrate ore from the Churnett Valley. It has been suggested that 213,500 tons of North Staffordshire ore came into the Black Country in 1854 (20), but if this figure is correct, there was a decline in the total tonnage after that date. According to Jones, 180,000 tons came in in 1865. By the early 1880's, when Hickman was obtaining his ore from the Froghall and Chatterley districts he was having to pay 10/- and 6/6 respectively per ton at the mine.(21) With the cost of carriage on top of this (3/6 to 5/- without wagons), he was hard pushed to compete with the price of Chatterley pig iron at 42/6.

It was with regard to Northamptonshire ore that the real test for the Black Country pig iron trade was to be presented. In 1843, S.H. Blackwell first had his attention given to the existence of ore in Northamptonshire, and he exhibited some of the ore with the rest of his collection of British ironstones at the 1851 Great Exhibition. Then, in January 1852, representatives of the Black Country industry made the journey to Northamptonshire to examine the ore in situ (22); the ore was hailed by the Press as "the salvation of that area". In that year and the next, large quantities of the ore were sent into South Staffordshire:

"But the Staffordshire people did not take kindly to the new ore. Their conservatism, and their lack of scientific knowledge of ores and of the processes of smelting anything but the local claybands,

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(20) K. Warren, op cit, p. 18.

(21) Select Committee on Railways, 1881, M.E. 4695.

(22) Mining Journal, 17/1/52. Also S.H. Beaver, The Geography of the Iron Industry of Northants, Rutland and South Lincolnshire, 1931, unpublished thesis of the University of London, p. 58.

conspired to make them belittle the Northants ore, which they slightly referred to as "rhubarb" (owing to its easy fusibility) and as "monkey dirt".(23)

Undoubtedly, the Northants ore was difficult to use in the average Black Country blast furnace by ironmasters accustomed to working with the more homogenous<sup>2</sup> clayband ores. The Northants ore was porous and friable and a lower temperature and smaller blast were sufficient to effect its reduction than were necessary in the case of the denser clayband ore. For example, when a mixture of the oolitic and clayband ores was used in the Black Country furnace, the former ore was melted by the great heat "before the reduction by the rising gases had had time to be properly completed"; as a result, "perhaps 10 or 20 per cent of the iron was run off in the slag, whilst a part of the gangue remained in the iron, rendering it weak and brittle".(24) In addition, the Northants ore was subject to great variation, as regards the proportion of iron, lime and silica which it contained; there were two distinct chemical types of ore, carbonate (which really requires calcining before use) and hydrated peroxide. It has also been suggested that the Black Country ironmaster would have been disconcerted by "the amount of soil and rubbish with which the early surface-worked ore must have been accompanied".(25)

Undoubtedly, the Black Country ironmaster was conservative and prejudiced; more important in the case of Northants ore, however, was his ignorance of science. John Gibbons had shown that detailed attention given to a system of material and quality control would pay off in the

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(23) S.H. Beaver, loc cit, p, 58.

(24) Mining Journal, 10/9/55 and 10/11/55.

(25) S.H. Beaver, loc cit, p. 60.

case of the use of tap cinder in the blast furnace burden, but few local ironmasters had been prepared to learn from his example. No 'analytical chemistry' was practised by the Black Country ironmasters, although it was used in the Cleveland district at this time. Without wanting to be harsh on the South Staffordshire iron industry, it certainly missed a good opportunity in the 1850's and 1860's by failing to make full use of the close proximity of the Northamptonshire ore. Peter Temin(26) rejects the idea that a more thorough exploitation of the Lincolnshire and Northamptonshire ore fields in the 1890's and 1900's would have helped the British iron and steel industry to ward off the competition of the Continent, but the significance for the Black Country iron trade would have been enormous if the ironmasters could have possessed those qualities necessary for the full exploitation of the ores at this earlier date. In one sense, the iron industry of the United Kingdom in the 1850's and 1860's was at the point of large-scale change in location. The Cleveland district occupied a near perfect situation; as well as its own local ore and coal supplies, it was admirably located to receive ore from overseas, especially from Spain. The Black Country was in exactly the reverse situation; overseas supplies of ore could offer no hope for the future of the iron trade there. To remain in the front line of iron producing areas, the Black Country industry had to seize upon every opportunity which presented itself.

The poor state of the South Staffordshire iron trade in 1854 was blamed for the most part on the low quality of the iron produced from the Northants ore.(27) Although the ore could be bought cheaply enough a number of ironmasters chose not to use it for fear of having their customers go elsewhere - even a small proportion of Northants ore was

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(26) P. Temin, The Relative Decline of the British Steel Industry, 1880-1913, 1964, pp. 152-3

(27) Mining Journal, 25/8/55.



sufficient to "totally condemn the iron by the finished iron manufacturers".(28) Again, Gibbons had found the same attitude on the part of the puddlers towards his cinder pig; again, too, he had overcome any difficulties when using cinder pig by giving his personal attention to the weighing of the pigs in relation to the amount of fuel used in the puddling furnace. Unfortunately, this degree of production management generally was not found throughout the ranks of Black Country ironmasters. By the end of the 1850's, Northants ore was obviously being used by a number of smelters in the South Staffordshire district as an admixture with claybands. The prejudice and lack of scientific knowledge obviously remained, and not all ironmasters were open about their use of the ore. One writer informed the readers of the Mining Journal:

"I have seen contracts where the ironmaster has been prohibited using it in any shape".(29)

Ten years later, despite the fact that now thousands of tons of the oolitic ore were being consumed in the district this attitude remained:

"... the use of a small proportion of this ore with Staffordshire claybands in smelting was, and in many cases is now, sufficient to suspend orders".(30)

Despite the fact that there was a decided South Staffordshire preference for Northants pig iron rather than the ore after the early 1860's, it is clear that by 1880 the former district was relying heavily on Northants ore to remain as a producer of pig iron. According to Alfred Hickman, ten out of every eleven pounds of iron ore used in the district were brought in from outside;(31) his railway opponents before the same

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(28) Mining Journal, 12/6/69.

(29) Mining Journal, 23/7/59.

(30) Mining Journal, 12/6/69.

(31) Select Committee on Railways, 1881, M.E. 4567.

Select Committee were adamant in their belief that the Black Country pig iron department could not have existed without Northants ore. In fact, the South Staffordshire industry was reproached by a member of the Select Committee for failing to see that the local ores would become exhausted, and this view, although unfair - for which iron producing area in the United Kingdom was totally self-sufficient in ore by this time - only underlined the point made previously.

Accepting the difference in size - and the fact that the Northants ore needed the addition of manganese to render it suitable for the production of basic pig - the main difference between the development of the Northants ore field and that of Lorraine rested in the ownership of the ironstone quarries. Almost every mine and blast furnace was part of a vertically integrated system, a fact which went a long way "towards the reduction of transport and re-heating costs, and towards the attainment of a high level of economic efficiency".(32) In Northants, on the other hand, for more than the first twenty years in the life of the iron district there, all those quarries which were not controlled by the local blast furnace concerns, were in private hands, or administered by small ironstone companies who sold wherever they could find a market. The South Staffordshire ironmasters, large or small, made very little effort to acquire quarries in Northants, the exception being Samuel Lloyd, formerly an active partner in the family firm at Old Park, Wednesbury. Lloyd first showed interest in Northants ironstone in 1880, but by then he had very little direct interest in the Black Country pig iron trade. Indeed, the first of the 'outside' works to enter Northants was the Stanton Company, which began to quarry ore in 1871.(33)

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(32) S.H. Beaver, loc cit, p. 162.

(33) F. Scopes, The Development of Corby Works, Stewarts & Lloyds Ltd., 1968, p. 5. Lloyds Ironstone Company was, of course, acquired by Alfred Hickman Ltd. in March 1919. See G. Morton & M. Le Guillou, loc cit, p. 15.

By 1910, out of a total of about 27 workings (excluding those owned by the local smelters), only ten belonged to 'foreign' ironworks, mainly of the old established works of north-east Derbyshire (Staveley, Sheepbridge, Clay Cross etc.).(34)

Because of South Staffordshire's failure to accept the potential of the Northants ore, a large part of the output was 'diverted' to Derbyshire, Nottinghamshire and South Wales.(35) Consequently, ore supplies to the Black Country remained suspect, and a number of ironmasters were always ready to investigate finds of ironstone in other midland counties. In the 1850's, workings of ironstone took place at Fawler, in the Banbury district of Oxfordshire. The land was conveniently adjacent to the Oxford, Worcester and Wolverhampton Railway (the Wolvercot Junction to Evesham section had been opened in 1853); intermittent working of these pits occurred.(36) Like the Northants ore, the Oxfordshire ore was found near the surface, or with only a thin over-burden of earth to be removed; the cost of extraction, including the loading of the ironstone either into trucks or on to boats on the Oxford Canal, could be as low as 1/- per ton. When Samuel Lloyd heard that iron ore

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(34) S.H. Beaver, loc cit, p. 163.

(35) For example, the Blisworth Mines of G.E. Bevan and Company Limited, opened in 1863, originally sent the ore in almost equal amounts to Staffordshire (by the Grand Union Canal), Derbyshire and to South Wales (by rail). Two years later, almost all the ironstone was going to South Wales. (Evidence of an 1865 delivery book, quoted by E.S. Tonks, The Ironstone Railways and Tramways of the Midlands, 1959, p. 12.)

(36) E.S. Tonks, op cit, p. 238. See also Geological Survey of Great Britain, vol. The Liassic Ironstones, 1952, pp. 140 - 198.

from the Adderbury area was being used at the Parkfield Iron Works in Wolverhampton, he showed keen interest in this and acquired the mining rights:

"... the Oxford Canal passed through the property offering every facility for the loading and despatch of the ironstone as soon as raised, and, as the canal tolls to South Staffordshire were very moderate and as all the South Staffordshire furnaces were on the canal it made a trade possible and profitable".(37)

The problem with Lloyd's acquisition, and others in the district, was that it was soon worked out. Exploitation on a large scale was, therefore, not possible.

By far the most important South Staffordshire ironmaster to develop ironstone quarries in Oxfordshire was Sir Alfred Hickman. He acquired the Adderbury Pits of the Adderbury Ironstone Company in 1889; these pits had been previously worked for a few years in the 1860's and then throughout the whole of the 1880's. They were worked regularly by Hickman for seven years or so, but only intermittently after that date. The opening of the King's Sutton to Kingham railway line in 1887 provided an incentive for local Oxfordshire landowners to encourage ironmasters to come and look for ironstone on their lands. In the mid-90's, Hickman decided to begin working the ore found on the estates of Sir William Richard Brown of Ostrop (Astrop) House. He spent between £9,000 and £10,000 on the works(38); between the pits and the Great Western Railway's 'Astrop Siding', Hickman laid a tramway of 2-feet gauge. Having decided that it would reduce his transport costs to Wolverhampton by up to one-third(39), Hickman also erected five 80-feet high Conyers kilns in which

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(37) "Samuel Lloyd's Reminiscences", quoted by F. Scopes, op cit, p. 43.

(38) Colliery Guardian, 18/2/98.

(39) Colliery Guardian, 1/12/99.

to calcine the ore:

"(the) kilns were erected alongside the standard gauge siding; the narrow gauge tramway was carried on a wooden viaduct to the top of the kilns where a tipper was installed so that waggons could be emptied directly into the kilns. A mixture of ore and coal was introduced thus and the calcined ore afterwards loaded into standard gauge waggons via chutes at the feet of the kilns".(40)

The Astrop Mines came into operation in 1897. Meanwhile, Hickman was prospecting in other parts of the neighbourhood. He was reported to have sunk several trial holes at Aston-le-Walls, about six miles from Banbury, but it is doubtful if he ever mined there.(41) The most distant pit from the railway line which he quarried was the one at Burton Farm, situated a little over two miles from the Great Western line. No narrow gauge track was laid in this case; instead, ore was carried by a cable line. This was partly due to the fact that Hickman did not feel that the reserves of ore justified the expenditure on a track. The pits were always shallow and in general the working depth was less than the 20 feet maximum permissible to obviate compliance with the Quarries Acts.(42) Contemporary observers gave a somewhat idyllic picture of the method of mining adopted in the Banbury area:

"... the method of mining is somewhat peculiar. All the ore lies within a few feet of the surface, and it has simply to be dug out and loaded into trucks which stand on a temporary siding".(43)

Besides, the Oxfordshire countryside was not to be raped as had occurred

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(40) E.S. Tonks, op cit, p. 241.

(41) Colliery Guardian, 1/12/99.

(42) E.S. Tonks, op cit, p. 241.

(43) Colliery Guardian, 1/12/99.

in South Staffordshire. It was reported that "a condition of the mineral leases is that, as the iron ore is removed, the surface soil shall be at once replaced, so as not to interfere with utilisation of the property for agricultural purposes more than is absolutely necessary". Mechanical shovels were not used in the excavation of the ore; as a result, the work was hard and the pay small - 4d. per ton for wet ore, 3½d. for dry, 20 tons per day being the average output per man; 3d. per yard for 'baring' (removing the overburden) and ¼d. each for tipping wagons. The Sydenham Pits, a small, compact system lying to the west of Kings Sutton, completed the Oxfordshire ironstone interests of Alfred Hickman, Limited before the First World War. The quarries were not actually opened until March 1914, but development after that date was rapid. Unlike the Astrop Mines, steam locomotive power was used along a narrow gauge railway. Mechanical excavation was also tried out, but was soon abandoned because of the amount of "rubbish" which was taken up at the same time as the ore. When the ore had been calcined locally, it was run directly into railway wagons for conveyance to the Spring Vale furnaces.(44)

Charles Cochrane, proprietor of the Woodside Ironworks, Dudley, also bought ironstone leases in Oxfordshire. The West Adderbury Pits were purchased in 1904 from the Hook Norton Ironstone Partnership. The Round Oak Iron and Steel Works were reportedly interested in developing quarries in the Banbury region in 1898 and 1899 (45); in fact, they purchased the last quarry reached on the line from Kings Sutton

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(44) During the war, the company rapidly used up their Oxfordshire ore reserves, a fact which explains why, in March 1919, the whole of the share capital of Lloyds Ironstone Company, Limited was acquired by Alfred Hickman, Limited.

(45) Colliery Guardian, 1/12/99.

to Chipping Norton. The ore outcropped on the valley side and, after being calcined in a kiln at the foot of the valley, was conveyed via a cable-worked incline up to the railway line - "a unique arrangement as far as the Midlands ironstone industry was concerned".(46) The ore was worked from about 1900 onwards, but not without considerable difficulty and several particularly lengthy stoppages. Round Oak also received Oxfordshire ironstone from the Hook Norton Quarries, owned by H.W. Baker and Sons. These quarries were in operation from about 1895 to the end of the First World War; ore was sent in small quantities to Lilleshall as well. The only quarries to the north of Banbury owned by a Black Country firm were the Burton Dassett Quarries, which were taken over by the Willingsworth Iron Company in the early 1900's.

In their search for Oxfordshire ironstone, the Black Country ironmasters faced competition from their counterparts in other iron-making districts. In 1899, for example, the Brymbo Company had acquired a large area of land in the Banbury district on which they were reported to have spent £13,000 on plant:

"They propose to send the iron ore, after drying it, on to Wrexham, so as to economise freight. Two drying kilns, each 70 feet high, have been completed, and a third is in course of erection. ... A steam lift of sufficient power to lift the loaded trucks to the top of the kilns and pour in the contents is being provided and will enormously reduce the cost of labour".(47)

Undoubtedly, those Black Country ironmasters who took the initiative and acquired mining leases in Oxfordshire were well rewarded. The Spring Vale Works, a point repeatedly made in this thesis, was perhaps the leading producer of iron and steel in the district after 1890.

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(46) E.S. Tonks, *op cit*, p. 257.

(47) Colliery Guardian, 1/12/99.

There was very little reason why more South Staffordshire ironmasters should not have followed Hickman's lead.

Raw Materials Consumed in South Staffordshire, 1896 & 1898.

<u>Material</u>	<u>Tons</u>	<u>Tons</u>
	1896	1898
Pig Iron Made	326,702	332,869
Iron Ore	659,096	738,244
Coal	597,330	711,509

Fuel Supplies.

Any study of the coal resources of the Black Country in the period under review can, as in the case of iron ore, begin with the papers presented to the Birmingham Meeting of the British Association in 1865. In the first district referred to by Samuel Bailey of Walsall, coal was found in four different seams - Brooch, the Thick or Ten Yard Coal, Heathen and New Mine. The Tick Coal, the most famous in the whole district, was used raw for smelting in the blast furnaces, whilst the Heathen Coal was used for coke-making.(48) The second district also contained Thick and Heathen seams, as well as New Mine, Fire Clay and Bottom Coal. The New Mine and Fire Clay Coal was used raw in the blast furnaces. The third district did not contain the most valuable seam, but it did have the Yard Coal (used raw), together with Heathen, Four-Foot and Bottom. The fourth area, also without the Thick Coal seam, had four different seams, whilst the Cannock Chase area had Yard, Shallow and Deep Coal seams. Something like 20,000 tons was the yield per acre of Thick Coal, and Bailey suggested that the height of working at the district, the coal and ironstone obtained per acre was valued at £20,000.

Having given the barest of outlines, as presented by Samuel Bailey, it is necessary to look a little deeper into the situation. A few years before the Birmingham Meeting of the British Association, Bailey had

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(48) Ed. S. Timmins, op cit, p. 27.



read a paper to the North of England Institute of Mining Engineers in which he had expressed some reservations about the coal-mining industry in South Staffordshire. Whilst accepting that the district possessed coal "in abundance, and of a quality suitable above all others for making iron", he pointed out that the landlords were still thinking in terms of the hey-day of the Black Country as an iron producing centre when they made their royalty charges - they still wanted 2/6 per ton royalty on ironstone, for example, "which cost 8/- to 10/- to raise". Bailey severely took the mine agents to task:

"... it is for them to bestir themselves, to lay aside the old methods of their forefathers, to improve and re-arrange their pits, workings, and machinery, and economise the labour of men and horses, aboveground, and more especially underground".(49)

On this occasion, the central theme of Bailey's argument was that the mining industry needed rejuvenating. He put forward the following ideas:

"... our winding machinery to be improved, more extensive underground workings to be opened, skips, wagons and tram-roads to be better constructed, so that instead of raising seven or ten skips an hour, thirty or forty may be drawn, and instead of sixty tons per day, 250 or 300 tons must be raised, for it is quantity also that must answer the purpose intended of reducing the cost per ton".(50)

Bailey also advocated the use of steam power in the pits. Unfortunately, very few of the mine-owners in the Black Country were prepared to take such advice. Mismanagement in the mines clearly hastened the process which was leading to the exhaustion of the better coal seams.

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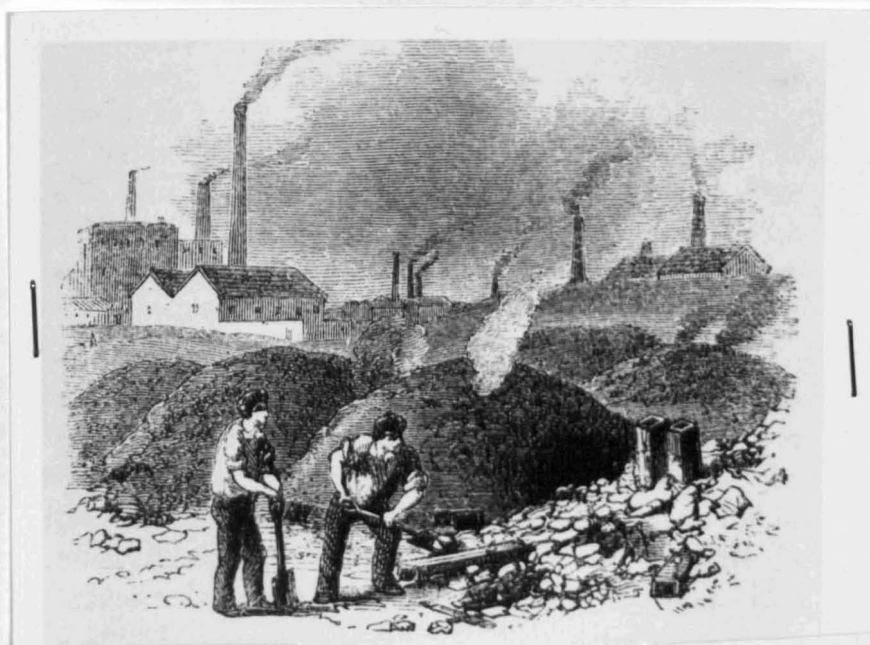
(49) S. Bailey, loc cit, p. 29.

(50) Ibid, p. 29.

Although not as significant as the developing local ironstone shortage, there was an indication of the impending shortage of coal in the 1840's. Only in certain districts of the Black Country was this trend pronounced, but by coincidence it was the reverse of the ironstone situation in that the main shortages were to be found in the northern part. Once started, the exhaustion of the better seams, and especially of the Thick Coal, gathered momentum; there were frequent references to it in the 1850's and 1860's. The coal situation was, in fact, worse for the blast furnace operator than for anybody else in the district; he could only use the Thick Coal, Heathen Coal, New Mine and Fire Clay Coal and the Yard Coal in the blast furnaces. In the 1860's and early 1870's, the national coal situation was giving cause for concern - these were the years of the 'coal famine'(51) - and both a Royal Commission (1869-71) and a Select Committee of the House of Commons (1873) did little more than elaborate on the difficulties; nowhere was the coal shortage more desperate than in the Black Country pig iron industry. In the space of twelve months in 1871-2, i.e. during the boom which followed the Franco-Prussian War, coal prices rose by 80 per cent. In wide areas of the district, no suitable local coal was available for the blast furnaces. The sorry misuse of the mines was now only too apparent; mine flooding was a significant legacy of the wasteful and indiscriminate mining methods of the previous fifty years or so. The Old Hill Mines Drainage Company Limited, of 1870, was quite inadequate to deal with the situation and in 1873 the South Staffordshire Mines

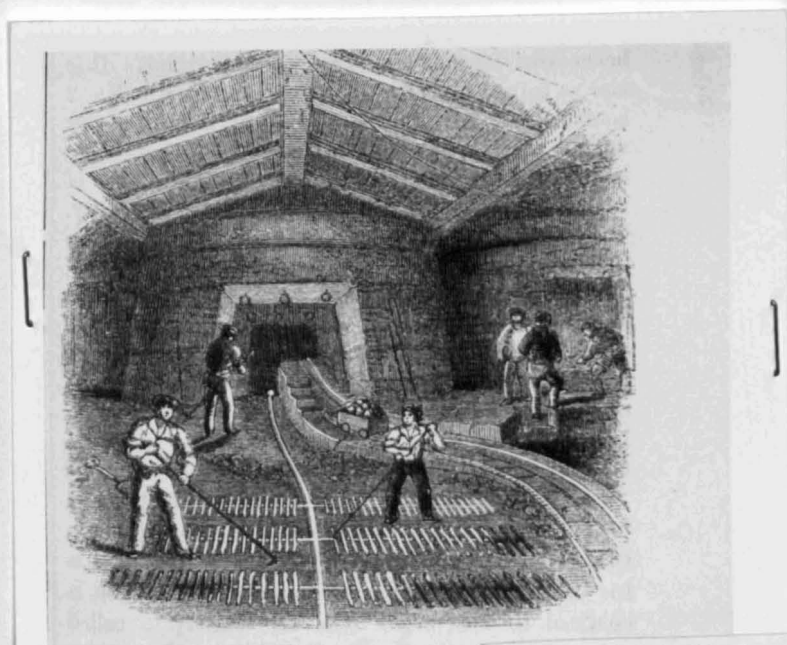
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(51) J.I.S.I., i, 1882, p. 128



COKE HEAPS NEAR DUDLEY.

Fig. 10



CASTING PIG-IRON.

Fig. 11

Drainage Act was thought necessary. Henceforth, a Mines Drainage Commission had powers to act and bring in measures to be paid for by the mining industry. Having elaborated upon the shortage (and dearness) of coal for the pig iron department, it must be stressed that the other branches of the iron industry were in a much better position; the abundant supplies of slack available at nominal cost were used for firing boilers and stoves.

A major short-coming of the leading South Staffordshire coals was that they were not coking coals in the modern sense of the term. The Thick Coal was of the "Clod" variety, i.e. "with a high durain content, 78 - 81 per cent carbon, very low in sulphur, and weakly-swelling", (52) and only the lump coal was used in the coking process. The slack, on its own, would not agglomerate or "cake". The wastage of Thick Coal was, therefore, enormous and the primitive mining methods used only made matters worse. Some pits adopted the practice of not bringing the slack to the surface; once worked out and left standing idle, the pit's slack often caught fire and, in some cases, continued burning for years. Even when the slack was thrown on surface pit-heaps, it would remain unused and spontaneous combustion would reduce it to ash and clinker. A number of methods were tried to make coke from the slack. Jones (53) mentioned the "great value" if some economic process could be discovered by which "the material could be converted into coke". Hitherto, uneconomic coke had been made with the slack either by mixing it with Welsh coal or by adding "a considerable proportion of coal-tar". J. Percy recorded one such attempt at Dudley when  $4\frac{1}{2}$  tons of slack were put in an oven with

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(52) S.H. Beaver, Coke Manufacture in Great Britain: A Study in Industrial Geography, Transactions & Papers, 1951, Publication No. 17, p. 134.

(53) Ed. S. Timmins, op cit, p. 65.

one ton of coal-tar pitch.(54) C.W. Siemens also tried his hand at turning the slack into a saleable coke with his regenerative "breeze-oven"; in this case, the coke would have been for forge purposes only.(55) In fact, little or no progress was made in this direction, and as late as 1898 Le Neve Foster was suggesting that a fortune awaited the man who could find a way of making cheap coke from the slack. "Broadly speaking, the South Staffordshire iron industry went on using either hearth coke or raw lump coal and the slack remained unused".(56)

The "hearth" process of making coke, the only method in general use in South Staffordshire for much of the nineteenth century, was both slow and wasteful. J. Percy has pointed out that in the Dudley area in the middle of the century it took ten days before the coke could be quenched and drawn from the heaps.(57) Jones spoke of "antiquated arrangements" with regard to the coke-making processes in the mid-sixties, and he could see no immediate prospect for change.(58)

Inevitably, the Black Country ironmaster became more and more dependent upon outside supplies of coke; the fact that this was so was undoubtedly one of the most serious shortcomings in the structure of the local industry. Besides, because of the lack of progress in coke manufacture in Britain throughout the second half of the nineteenth century, the South Staffordshire industry was faced in an exaggerated form with one more factor making her less competitive in an international sense.(59)

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(54) J. Percy, Metallurgy, i, Fuel, etc, 1875, p. 424. See Figure 10,

(55) Ibid, pp. 456 - 8.

(56) S.H. Beaver, loc cit, p. 135.

(57) J. Percy, op cit, p. 424.

(58) Edited S. Timmins, op cit, p. 65. Also S.H. Beaver. loc cit, p. 135 and W.K.V. Gale, The Black Country Iron Industry, pp. 43 - 44.

(59) Because there was little coke-making in South Staffordshire, I have not included a detailed account of that industry in the main body of the thesis. However, because the coke situation was so crucial for the industry an account is given in the form of an appendix.

A number of Black Country ironmasters sought to acquire mining rights outside their own district, although this trend was by no means a general one. Alfred Hickman, for example, purchased coal mines in the Bedworth district of Warwickshire. He, like many of his fellow ironmasters, was still faced with the task of obtaining coke supplies for his works at Spring Vale. Hickman's blast furnaces were run on a mixture of raw coal and imported coke; in the 1870's, for example, he bought his coke from three areas - South Wales, South Yorkshire and North Staffordshire. In the case of the coke from the first area, he was paying 16/6 per ton in 1876, delivered at his works. Although Hickman himself chose to play down the district's dependence on outside supplies of fuel before the 1881 Select Committee on Railways, George Findlay, Manager of the L&NWR, emphasised the fact that Hickman had "to go far afield for coke to work his furnaces"

"... he gets a quantity from Staveley, upon the Midland Railway; he gets some from Talk-o'-the-Hill, in North Staffordshire; he gets some from Pemberton, in our Wigan district; he gets also from Ruabon a quantity of coke..."(60)

Five years later, this time before the Royal Commission on the Depression of Trade, Hickman informed the Commission that he had bought 10,000 tons of coke at a time from the Staveley Company. Apart from the freight-cost issue, the organisation to maintain the smooth operation of supplying the district's few remaining large iron and steel works was considerable. Patent Shaft, for example, consumed a very heavy tonnage of coal in the three-year period 1899 to 1901, much of it having to be imported into the Black Country:

<u>Year</u>	<u>Coal Consumed</u>	<u>Cost</u>	<u>Av. price per ton</u>
	<u>tons</u>	<u>£</u>	
1899	168,032	50,804	6/1
1900	174,625	72,089	8/2
1901	160,211	83,994	10/6

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(60) Select Committee on Railways, 1881, M.E. 14382.

The tonnage figures for coal/coke which passed through Wolverhampton were considerable; after 1885, the annual figure did not fall much below 80,000 tons and for three years it was well over 100,000 tons.

Mineral Traffic through Wolverhampton, 1885 - 1899.

<u>Year</u>	<u>Coal &amp; Coke</u>	<u>Tons</u>	<u>Other Minerals</u> (iron ore & limestone)
1885	82,571		75,132
1886	80,310		71,544
1887	77,640		84,718
1888	83,709		96,279
1889	86,112		112,690
1890	81,435		93,903
1891	91,630		111,436
1892	87,218		111,204
1893	78,703		134,850
1894	82,234		140,153
1895	115,556		139,436
1896	106,295		159,602
1897	111,710		184,124
1898	89,358		190,412
1899	95,623		194,735 (61)

Another very serious aspect with regard to the supply of coke was the difficulty of maintaining supplies at a price which the ironmasters could afford and still make a profit from the sales of their pig iron. This was very marked in the comparatively prosperous years between 1896 and 1900. The price of coke trebled in some cases, and in September 1899 the Black Country ironmasters were reported as being "bewildered at the manner in which the prices of ironmaking cokes are rising".(62) Things proved too much for at least one ironmaster; in September 1900, Messrs. Round Brothers of the Tividale Ironworks "decided to blow out their blast furnaces forthwith".(63) In August 1898, a "coke famine" had occurred, in part due to the South Wales coal strike, and in the July of the following year, it was again reported that "a serious situation (had) arisen owing to the famine in iron-making cokes. Certain leading pig iron firms (had) declared themselves unable to get sufficient

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(61) Chamber of Commerce (Wolverhampton) Statistics, 20/5/98.

(62) Colliery Guardian, 4/9/99.

(63) Colliery Guardian, 28/9/1900.

coke to keep the furnaces going".(64)

The situation with regard to coke supplies remained virtually the

Coke Prices (January of each year unless otherwise stated)

Type of Coke	1896	1897	1899	1899(June)	1900	1901
Best blast furnace	13/- - 16/-					
Derby. furnace coke			17/-	21 - 22/-	30/-*	
Best " " "				27/-		
South Wales furnace				18 - 19/-		
" " foundry				26 - 28/-	40/-	30/-
Durham furnace				32 - 34/-	40/-	32/6

\* price at ovens

same throughout the Edwardian years; prices tended to fluctuate a good deal and there was little that the Black Country ironmaster could do. In slack periods for the iron trade, coke could generally be obtained cheaply; when the pig iron makers were able to obtain a better price for their goods they were faced with a combination of coke scarcity and high prices. Frequently, pressure was put upon the blast furnace owners by the finishing department to lower the price of their pig iron; on every occasion the former were unable to oblige because of the high cost of their fuel.(65)

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(64) Colliery Guardian, 14/7/99.

(65) Colliery Guardian, 31/1/08 and 12/6/08.



## Chapter 4 Developments in Transport in the Black Country.

Because of its midland location, the South Staffordshire district had required a fairly sound transport system from the beginning of its industrialising process. Canals had provided just such a system; by the late 1830's some "four million tons of coals, lime, ironstone and other raw materials" were carried on the canals of the Black Country, together with nearly 240,000 tons of iron and "large quantities of heavy hardwares, tin plates, glass and other goods" annually for export from the district.<sup>(1)</sup> London was the most important port for the Black Country, taking 42 per cent of its exports, followed by Liverpool (37 per cent), Hull (13 per cent) and Bristol (8 per cent). In 1836, a sample year taken before the coming of the railways, the rates to London from Birmingham by canal were as follows:

<u>Articles</u>	<u>Rates by canal collected &amp; delivered</u>	
	<u>Per ton</u>	
Undamaged iron	25/-	
Damageable iron	27/6	
Hardware	60/6	
Nails	40/-	(2)

From the Dudley area to Liverpool, by the Shropshire Union and the Bridgewater Trustees, in the late 1830's, the rate for undamageable iron (pig iron) per ton was as low as 6/2 to 7/6 "delivered alongside ship by barge".<sup>(3)</sup> From Cookley (Kidderminster) to Liverpool by canal, a distance of around 110 miles, the rate for boxes of tin-plate was 12/6.<sup>(4)</sup>

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(1) Report of the Railway Department of the Board of Trade on the London, Worcester and Wolverhampton, and on the Birmingham and Shrewsbury Districts, 1845, p. 2. To support the Tame Valley Bill of 1840 it was pointed out by the proposers that along the two miles of canal in the centre of Birmingham, from Farmer's Bridge locks to Bordesley and Aston, there were seventy steam engines and 124 wharves and works.

(2) Select Committee on Railways, 1881, ii, Appendix No. 59.

(3) Ibid, M.E. 5451 - 5470.

(4) Ibid, M.E. 4610.

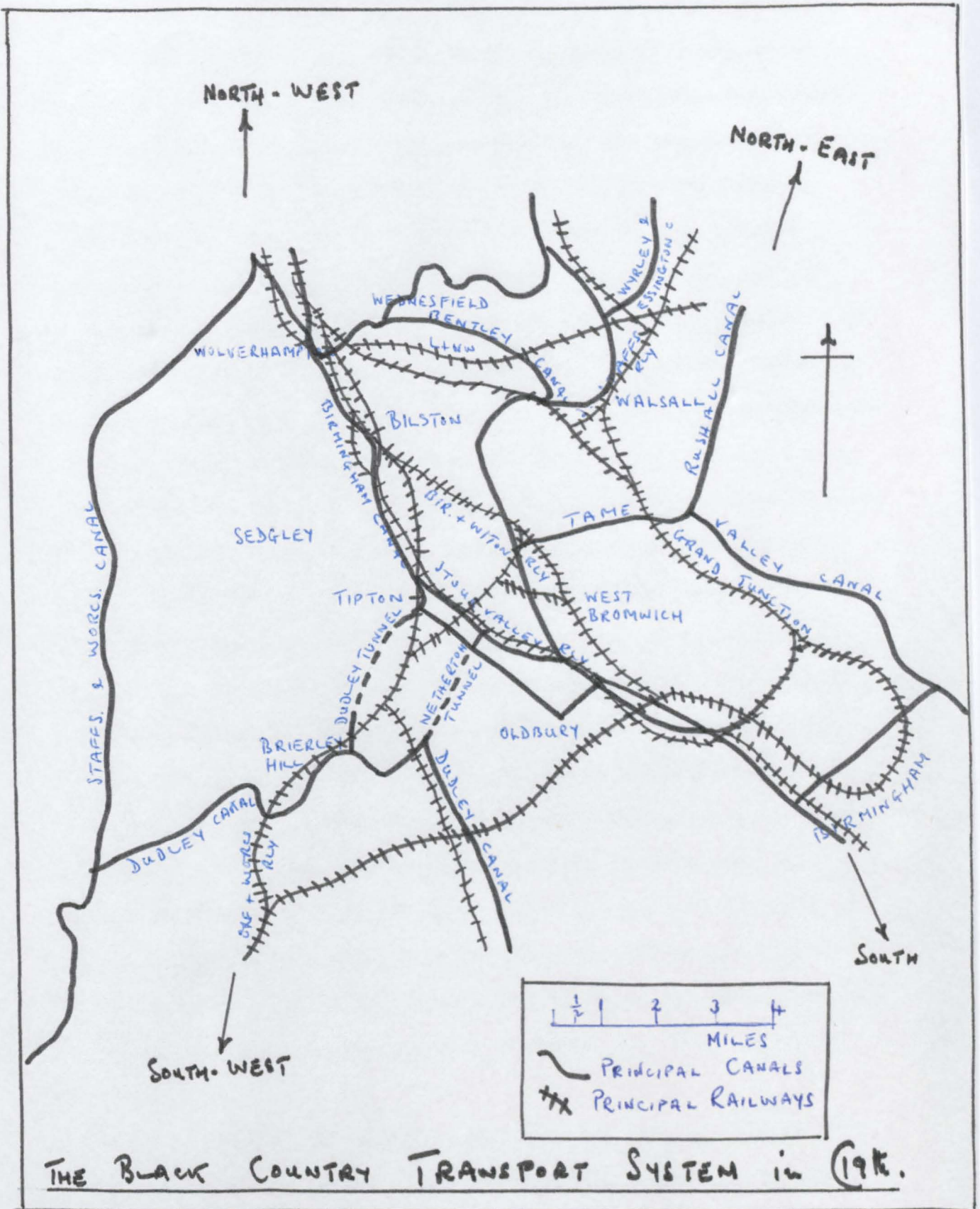
Despite this undoubted early contribution of the canals to the growth of the Black Country iron industry, it is true to say that by the late 1830's the canal system was beginning to display numerous inadequacies in the face of a changing situation. The rise of the near-coastal locations of South Wales and Scotland, with their "readier access to the sea" (5), meant that South Staffordshire's two great rivals could convey their products to export markets at far cheaper rates. Furthermore, the canal journey for heavy goods was always slow; it would take up to two weeks to cover the distance to Liverpool, for only in exceptional circumstances and with small cargoes would the fast boats do the journey from Dudley to the Mersey in three days. The Board of Trade's Departmental Committee recognised in 1845 that the canals were "not only more tedious and expensive, but subject to serious interruptions, often for weeks together, from frost in winter and drought in summer".(6) Equally significant was the growing strain being placed on the canal system within the district itself by the exhaustion of either coal or iron ore in one or other half of the district. Evidence before the Oxford, Worcester and Wolverhampton Railway Committee in 1845 suggested that 1,333 tons of raw materials were being transported every hour of the day in the Black Country district, and that the Dudley Tunnel had become very much of a bottle-neck. Boatloads ranged from fifteen to eighteen tons in this period, so it is not difficult to imagine the build-up of craft at both ends of tunnels. Besides, the important Netherton Tunnel was not opened until 1858.

By the mid-1840's, the Black Country was in the position of being able

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(5) 1845 Report, p. 2.

(6) Ibid. The whole canal system in the area was affected by the South Staffordshire plateau; in whichever direction the canals went they pursued a downward course with inevitable loss of water. An indication of the BCN's water supply difficulties is to be seen in that of 54 pumping engines made at Soho between 1777 and 1828, nineteen were purchased by that company.



to judge the benefits which could come to the district with the railways. In 1845, the London and Birmingham Railway opened a goods department in Birmingham, and almost immediately a means of communication was opened with the Birmingham Canal. (7) In the same year, the Railways Committee of the Board of Trade was listening to the claims for rival schemes proposed by the London and Birmingham Company and the Great Western Company. The routes under discussion concerned London, Worcester and Wolverhampton, and Birmingham and the Shrewsbury district. A majority of local businessmen - representing 46 ironworks, 57 furnaces and 98 collieries (8) - favoured the scheme put forward by the London and Birmingham line, one important factor being that the Great Western Company's gauge did not conform with the more usual narrow-gauge system. A break of gauge at Birmingham would seriously hinder the district's traffic with all ports except Bristol. Bearing in mind the future difficulties of the district with regard to the mineral traffic, it is interesting to note that one of the factors which influenced the Board of Trade team to recommend acceptance of the London and Birmingham's proposals were the plans of that company "to lay down an additional double line of rails throughout the mineral district, to be devoted entirely to the accommodation of the mineral traffic". (9) It was felt that the cheap transit of coals and minerals would obviously help the industry of the area, but would also bring a "still more important benefit for the poorer and industrious classes". The officials of the Board of Trade clearly foresaw the situation which, indeed, arose in the 1870's and 1880's when they wrote:

"It is only by obtaining ready access to the Railway by means of short branches or tramroads from those mines and works, that the benefits

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(7) Select Committee on <sup>R</sup>ailways, 1881, Appendix No. 58.

(8) 1845 Report, p. 7.

(9) Ibid, p. 8.

contemplated from the introduction of Railway communication can be fully realised. But if this is to be the case, and if any considerable portion of this immense local traffic is to pass by Railway, it is manifest that the rails so used could not be rendered available without extreme danger and inconvenience for the general traffic. Even the export trade alone in coals and iron could not be conducted with convenience upon the same line of rails in order to allow the waggons passing and repassing from the different works within the district to reach without interruption some principal station at its extremity, where trains of the proper size could be formed and despatched to distant parts". (10)

In 1881, the General Manager of the Great Western Railway, J. Grierson, admitted to the Select Committee that it would not be worthwhile for the company to see more coal carried between Round Oak and Hickman's works near Deepfields on the grounds that "it would have, and must have, the effect of blocking our main line, for the traffic would have to pass upon a very heavy incline, and the rate would be too low to block our main line for it". (11) In other words, although the railway companies initially made a case out that they would serve the area's needs with regard to mineral traffic, decades later this no longer held true. The Board of Trade officials were apparently also aware of the difficulties which would arise as a result of the fact that the majority of the ironworks would not lie alongside the railways. However, no serious thought was given to

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(10) Ibid, p. 8.

(11) Select Committee on Railways, 1881, M.E. 12838. Generally, promoters of railway lines were more interested in passengers than anything else: "Coal!" a certain Mr. B. of the London & Birmingham is reported to have exclaimed, when it was first suggested that his railway should carry so humble a commodity: "Why, they'll be asking us to carry dung next". W.M. Acworth, Railways of England, 1900, p. 153.

planning a sensible railway system for the area and within a short time a whole host of different companies had been brought into being. Even after the main amalgamation period had taken place there were three large companies serving the area. The Great Western, incorporated in 1836, came to control the Birmingham and Oxford Junction Railway (1852), the Shrewsbury and Birmingham Railway (1854) and the West Midland (1863), which included the Oxford, Worcester and Wolverhampton Railway. The LNWR came into being in 1846, arising from an amalgamation of a number of companies, one of which was the London and Birmingham; in the following year, the Shropshire Union and the Birmingham, Wolverhampton and Stour Valley Railways were acquired, followed by the South Staffordshire (1867) and various lines on and near Cannock Chase (1870). The Midland Railway arose in 1846, resulting from an amalgamation of the North Midland, Midland Counties and the Birmingham and Derby Railways. In the following year, the Birmingham and Gloucester Railway was acquired. It is worth bearing in mind that all the railways mentioned had been brought into being by separate Acts of parliament; significantly there was a number of variations with regard to maximum rate clauses and terminal clauses. Before 1845, parliament had not considered the latter, envisaging that the railways would be like the canals and that carriers would pay tolls for the use of the track, etc.. Initially, too, little thought was given to the possibility of the railway companies liaising with the canal companies, and as a result for a short period of time not only was there severe competition between the two modes of transport but the opportunity was lost of bringing about an integrated system of transport. Rather than face a continuous battle with the canals, the railway companies bought them out. The process was started by the Great Western when it purchased the Stratford-upon-Avon Canal in 1846, followed by the LNWR purchasing the lease of the Shropshire Union Canals in 1846-47.

In 1845, the Board of Trade officials spoke of the railways carrying coal to London from Staffordshire and Derbyshire for between 11/- and 12/-

a ton (best coal would be sold for 20/- compared with 30/- to 40/- in London during a frosty winter). Indeed, freight rates generally went down ; however, the rates which prevailed in the period of intense rivalry between the railway and canal companies could not be expected to last (although they were frequently quoted in the 1880's as the rates of "30 or 40 years ago"). By 1860, the railways were firmly in control, for they were carrying a larger proportion of the goods traffic in and out of the district than the canals. The railway route to London, by the shortest line, entailed a journey of only about 100 miles, compared with  $163\frac{1}{2}$  miles by canal; there were similar advantages to other major ports in the country. Professor Allen has argued that "had it not been for the railways ... South Staffordshire would have been rapidly sinking to a position of obscurity as a seat of pig-iron production ... and malleable-iron production". (12) On some routes water transport was, nevertheless, preferred; one example was the passage of nearly 100,000 tons annually of high-grade iron ore from the Furness area which came into Shropshire and Staffordshire "by coasting vessels, through the river Mersey, to Ellesmere Port and Runcorn, and up the river Dee to Chester...". (13)

The Black Country's increasing dependence on outside supplies of ore in the 1850's - 213,000 tons of calcined North Staffordshire ore and 120,000 tons of Northants ore annually - had brought to the forefront once again the absolute necessity of good and cheap transport facilities. Increasing competition from the leading British areas, notably Cleveland, and from "France and Belgium in the depressed years", made the South Staffordshire district increasingly aware of the "long haul to the sea". Local manu-

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(12) G.C. Allen, op cit, p. 100.

(13) Braithwaite Poole, The Commerce of Liverpool, 1854, p. 54.

facturers were not slow to blame the railway companies and to levy the criticism that the area as a centre of the iron trade was being strangled by high freight charges. The companies, for their part, regarded such views with disdain. What, then, was the situation with regard to South Staffordshire and freight costs in the period up to 1872, the year in which the Joint Select Committee on Railway Companies' Amalgamation met? Between London and Birmingham, the rate for undamageable iron was 15/- per ton, 17/6 for damageable iron, 35/- for hardware and 32/6 for rails; all quoted prices included collection and delivery. (14) Compared to the rates previously referred to for canal transport, these amounted to reductions of 40 per cent, 36 per cent, 54 per cent and 47 per cent respectively. Even compared with the canal prices of the period of intense rivalry, the railway rates in 1866 showed substantial reductions. From Wednesfield Heath, near Wolverhampton, to Liverpool, the rate on undamageable iron, including 1/6 a ton from the railway station to the ship, was between 8/- and 9/-. (15) Ore from Northamptonshire was brought into the district at the rate of 0.5d. per ton per mile, a rate which was low even when it was realised that either the ironmaster or the quarries supplied the wagons in which to carry ore. Inside the district, Alfred Hickman found things satisfactory enough to set himself up as an ironmaster. The Great Western Railway Company, for example, carried coal for him from Round Oak to his works at 6d. per ton. However, few local ironmasters were prepared to offer praise to the railway companies. In the first place, the three companies were known to have reached agreement, on 17 March 1863, "by which they are severally bound that neither of the companies

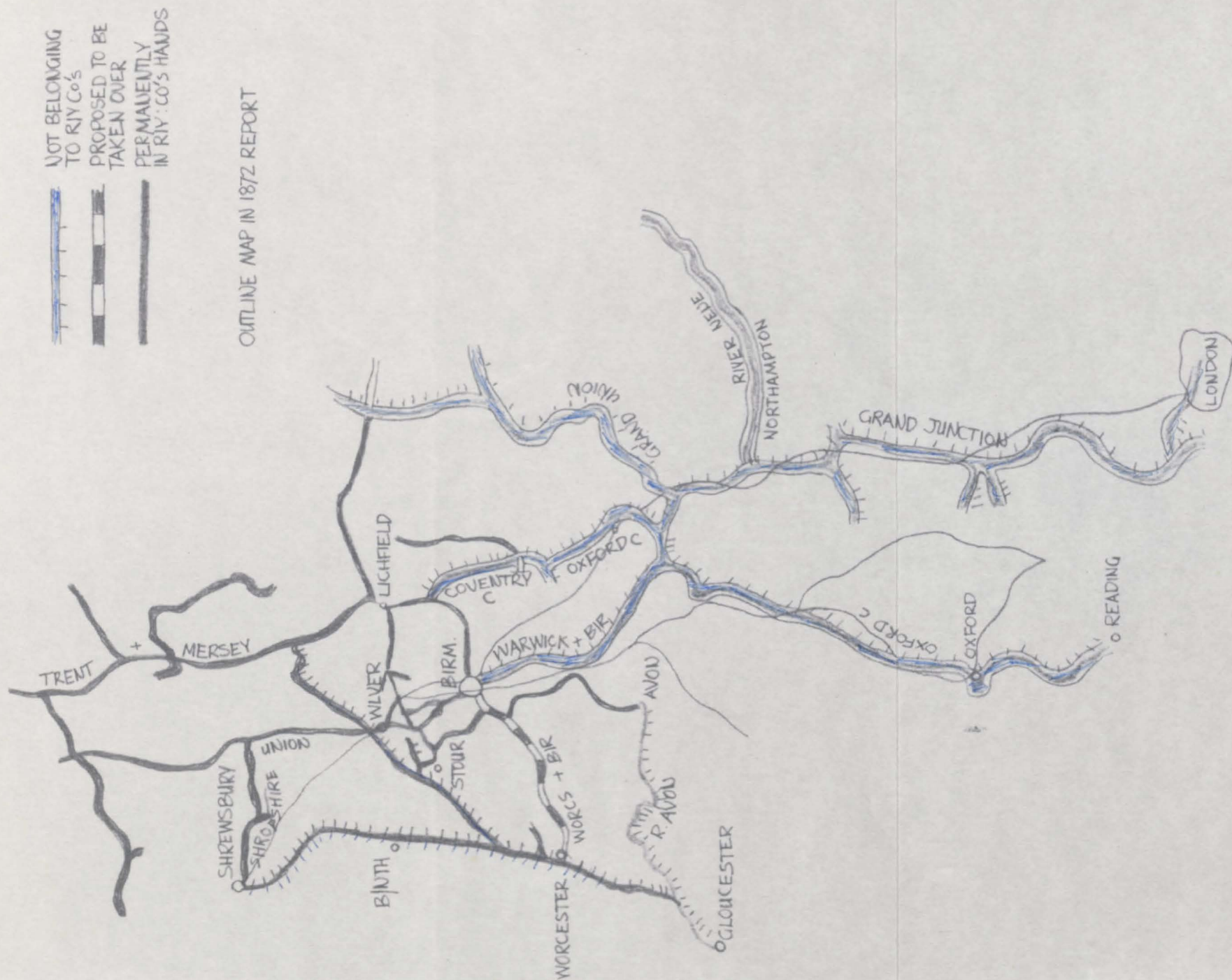
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(14) Select Committee on Railways, 1881, Appendix No. 59.

(15) Ibid, p. 243.



# Canals & Navigations—1872



should reduce any existing rate or give a new low rate without the consent of both the others".(16) In 1881, Hickman had no hesitation in agreeing to a suggestion by a member of the Select Committee that this agreement constituted what in the United States was termed a "ring".(17) Secondly, the railway companies had gone a long way towards crippling canal transport in the district. In general, once the railway companies acquired a canal then the through-rates on the canal were brought into line with those charged by the railways. By 1872, all the canals leading northward from the district were in the hands of the railway companies.(18) Even the most avid supporter of canal transport had to admit in 1872 that the railways were vastly superior over long distances; however, the railway companies clearly took action to ensure that the canals, both railway-owned and independent, would have a very hard time trying to compete with them. Unlike the railways(19) the canal companies had had to face competition from independent carriers using their canals. Tenders were

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(16) Report of the Departmental Committee on Railway Agreements and Amalgamations, 1911, M.E. 3982.

(17) Select Committee on Railways, 1881, M.E. 4445.

(18) Select Committee, 1872, pp. 480 - 81.

(19) Initially, and in order to overcome the difficulties of establishing through-routes between rivalry-minded railway companies, the companies had used private carriers on their lines - Pickfords for example - . However, with the adoption of the Clearing House practice, the system was dropped. Braithwaite Poole, who became chairman of the Railway Clearing House, argued that users thereby obtained lower charges. See P. Bagwell, The Railway Clearing House ..., 1968, pp. 64-70, and W.T. Jackman, The Development of Transportation in Modern England, 1966, p. 624 et seq.

frequently made for large contracts and occasionally the carrier, providing his own boats etc., would be able to outbid the very company along whose canal he paid a toll for the passage of his boats. Once a canal fell into the hands of a railway company, this position was terminated; either the private carrier was bought out or ruthlessly forced out of business. E.J. Lloyd (20) was of the firm belief that the railway companies in the Midlands area never intended to utilise the canals which they acquired. They were more interested in securing the traffic of the canals; he claimed that the Great Western had invested £633,036 in the canals, the revenue from which was £276. Taking the running costs into account, the canals annually made a loss of nearly £8,000. (21) As further evidence that the railway companies were intentionally running down their canals, Lloyd produced traffic figures for the Stratford-upon-Avon Canal (GWR) and for two independent canals - the Warwick and Birmingham and the Coventry Canal. The Warwick and Birmingham in one year carried 300,000 tons of long-distance traffic and a local traffic of another 200,000 tons. A mere 25,000 tons was carried on the Stratford-upon-Avon, which Lloyd suggested was virtually shut down. (22) The Midland Railway had allowed the Ashby-de-la-Zouch Canal to enter a similar state of "gradual deterioration". (23)

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(20) Lloyd was 'engineer and general manager' of the Warwick and Birmingham Canal Company, an independent canal. He gave evidence before the 1872 and 1881 Select Committees and, with the possible exception of Alfred Hickman, knew more about transport problems in the area than any other person.

(21) Select Committee on Railways, 1881, p. 459.

(22) Select Committee, 1872, M.E. 5036.

(23) A number of practices was used by the railway companies in the Black Country to placate the management and shareholders of the canal companies, including the guaranteeing of a fixed dividend and the appointment of former canal managers to the new boards of directors (without the right to vote).

Not content with running down the traffic on their own canals, the railway companies pursued a policy of non-cooperation with the independent canal companies. On one occasion, the Great Western arranged for one of its employees to purchase the upper Avon navigation for the purpose eventually of abandoning it. By this means the company was able to close the river Avon as a through route from Stratford to Tewkesbury, much to the annoyance of the Worcester and Birmingham Canal company who had leased from a Mr. Perrott the lower Avon navigation. They had agreed to pay the latter "400 pounds a year in perpetuity", but without the upper Avon navigation being open to them they had no means whatever of recovering even the £400, let alone running the canal at a profit. (24) The LNWR had acquired effective control over the very important Birmingham Canal, which, with its branches, covered 158 miles in length, and could be said literally to intersect the factories of Birmingham, and the collieries, ironmills, forges and foundries of the Black Country. The possession of this canal by a railway company seriously disrupted the flow of traffic on several of the more important independent canals who had made a number of "friendly agreements" as to the portion of the through rate which each would obtain. On the canal journey from the Staffordshire area to London - a distance of about 160 miles with a statutory total charge of 4/6 per ton of iron - the Birmingham Canal, covering a distance of less than a dozen miles, took 1/6, leaving 3/- for the independent canals (chiefly the Warwick and Birmingham and the Grand Junction). (25) Even on local traffic, the Birmingham Canal made full use of its central position by exercising a bar toll of 3d. in one direction and 4d. in the other. Lloyd explained the situation thus:

"Suppose my boat passes from our canal (Warwick and Birmingham) into

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(24) Select Committee on Railways, 1881, M.E. 10,184.

(25) Select Committee, 1872, M.E. 5032.

Birmingham, or from the Birmingham Canal into ours; if it passes only the length of a boat, if it only just crosses the canal, they charge the toll". (26)

For short distances the canal companies had been given the right to charge for fractions of a mile (the minimum charge being for one-sixteenth of a mile); in 1893, they sought permission from the Board of Trade to abandon the fractional charge and to levy a rate for one whole mile even if it meant that a boat had simply moved from one bank of the canal to the other. (27) A further obstructionist tactic of the railway-owned canals was for them to create long hold-ups for repairs to stretches of their canals or, particularly, to tunnels. The Gosty Hill Tunnel was a favourite

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(26) Select Committee on Railways, 1891, M.E. 10,141. Lloyd stated that in only two cases in the area did railway-owned canals show any increase of traffic, i.e. the Birmingham Canal and the Trent and Mersey. He was able to give examples of nine railway-owned canals obstructing through traffic etc. from private canals. With regard to the Birmingham Canal's importance, Lloyd told the Select Committee: "... this was really becoming what I may term an omnibussing canal for railway traffic. A very large proportion of the traffic on the canal is now the collection of goods from works, and carrying them to the railway sidings, and the canal business in connexion with the railways", M.E. 13,569.

(27) Colliery Guardian, 27/1/93. At the same time, the canal companies sought to abolish the system of contracts in the Black Country whereby the freighters had provided their own basins and wharfage accommodation in return for which they obtained freight reductions. The Board of Trade refused to accept this request which meant, "in scores and hundreds of cases, a saving in the cost of freightage of a suggested increase of 45 per cent". The Board of Trade also refused to accept the companies' request to abolish fractions of a mile, although they did agree that the minimum charge should be calculated at the rate of one-quarter of a mile.

for this type of tactic, the result being that canal traffic had to make a very long detour. By such devices as these, the railway companies made it almost impossible for the companies that owned the remainder of the lines of canal on a through route to maintain their traffic in competition with the railway. (28)

Whether justified or not, a majority of Black Country ironmasters were highly critical of the railway companies. At this point, as, indeed, three or four years earlier, there was little attempt to compare Black Country freight rates with those either elsewhere in the country or on the Continent; it was pointed out, however, that local nail sheet was having to face strong competition from Belgian sources on the London market. Local spokesmen were content to oppose railway amalgamation in principle. When the Wolverhampton Chamber of Commerce answered the questionnaire circularised by the Association of Chambers of Commerce in March 1872, doubts were expressed as to whether or not "economical management" followed amalgamations. Not surprisingly, the local chamber of commerce believed that every effort should be made to guard against "a combined Monopoly" arising in the case of canal companies being "bought, leased, or worked under any agreement with a railway company". (29) On this point, it is interesting to note that the 1872 Joint Select Committee recommended that "no inland navigation now in the hands of a public trust should be transferred to, or placed under the control of, a railway company".

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(28) W.T. Jackman, op cit, pp. 650-55. Most of Jackman's examples of unfair practices by the railway-owned canals were, in fact, taken from the Black Country even though he is supposedly writing about Britain as a whole.

(29) Minutes Books, Wolverhampton Chamber of Commerce, entry for March 1872.

Throughout the decade of the seventies, the many changes that had earlier got underway affecting the fortunes of the Black Country iron industry became more pronounced. Of those relevant to the transport issue the following can be mentioned:

- i. the area's almost total dependence by 1880 on imported ores;
- ii. the working out of that part of the thick coal basin upon which the earlier blast furnaces had been sited;
- iii. the dependence of the area upon outside supplies of pig iron;
- iv. the continued expansion of the Cleveland district and the growth of competition from other British coastal iron and steel producing areas, together with Belgian competition. (30)

In his evidence to the 1881 Select Committee on Railways, Alfred Hickman, acting as spokesman for the district's ironmasters, considered the quantity of ironstone brought into South Staffordshire to exceed "that produced there by the proportion of ten to one". (31) Three years later, no less than 80 per cent of the pig iron produced locally (279,360) was made from Northants ore. This fact is of the utmost relevance to Hickman's whole argument concerning the burden which high freight rates brought down upon the shoulders of the local pig iron manufacturer. He argued before the 1881 Committee that the local pig iron trade was "very rapidly becoming

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(30) "ailway rates were raised during the boom period of 1871-2, and not lowered with the onset of 'depression'. In the seventies, too, it became customary for the railway companies to drop the long weight (2,400 lbs.) in favour of the ton of 2,240 lbs. without any price reduction.

(31) Select Committee on Railways, 1881, M.E. 4318. Hickman was suggesting that, although at first sight the area was well located to receive both Northants and North Staffordshire ores, high freight rates made a mockery of this.

defunct" because of the "excessive railway rates on the material", i.e. the raw materials for the manufacture of pig iron. In working out the extent to which the railways "overcharged" local ironmasters, Hickman made too much out of the rates charged for North Staffordshire ironstone. He played down the fact, for example, that local pig iron was made from "a mixture of North Staffordshire, South Staffordshire and Northamptonshire ore"; the rates from Chatterley and Froghall were, indeed, high - 3/10 per ton without wagons (4/6 with) for a distance of 39 miles 53 chains from Chatterley, and 5/- without (5/8 with) wagons for the 47 miles from Froghall to Deepfields - but it was misleading to give the impression that 10 per cent of the selling price of pig iron was taken up by the "overcharge". Hickman made very little pig at Bilston from North Staffordshire ore alone; it was mixed with Northants ore which had been brought to his works at 0.5d. per ton per mile. Hickman claimed that if the railways could carry Northants and Leicestershire ore for 0.5d. per ton per mile, and presumably make a profit, why could they not do the same for the North Staffordshire ore? For their part the spokesmen of the railway companies denied that they were overcharging on the Chatterley and Froghall areas and that, in any case, the importation of iron ore into the district "at very low rates" was "the only thing to a very large extent which (kept) South Staffordshire going as it was". (32) The manager of the LNWR, G. Findlay, was especially adamant on this point:

"... in South Staffordshire no blast furnaces could exist at all if they had to depend upon native ore ... The only means by which the trade carried on at all is because the London and North Western, the Great Western and the Midland, carry Northamptonshire ore into the district; the North Western Company also carry hematite ore from Barrow ... at  $\frac{1}{2}$ d. a ton a mile into South Staffordshire, and the

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(32) Select Committee on Railways, 1881, M.E. 12,700 and 12,705.



North Staffordshire ore is brought in to a very considerable extent; we are carrying a very large proportion of the North Staffordshire ore at something like 1d. ..." (33)

Under cross-examination, Hickman had to admit that unless the lower quality ore had been brought cheaply from Northants few South Staffordshire ironmasters would have used it; the railway spokesmen chose to put it another way when they described the Northants rate as one "charged under exceptional circumstances", i.e. "to preserve the trade of South Staffordshire". A further factor to be borne in mind was that, except in the case of Northants, very few local ironmasters were prepared to take a full train-load of iron ore.

With regard to the assembly of coal/coke at the blast furnaces, Hickman and his fellow ironmasters were, perhaps, more justified in their criticism of the railway companies. Much of the coal trade was on a very local basis, and as such was extremely difficult to organise by the railway companies if they were to prevent their main lines from being cluttered up with coal wagons (the very point foreseen by the 1845 Committee). Consequently, the railway companies were not over-anxious to listen to the complaints of the ironmasters or colliery owners, or to make concessions. Indeed, it would appear that many of the local ironmasters were having to pay extraordinarily high freight rates on their supplies of local coal. Hickman, in his own evidence, said that it "took about  $2\frac{1}{2}$  tons of coal and slack together to make a ton of iron" and, as a result of the alleged "overcharging" by the railway companies he had to pay an additional 10 per cent on the price of a ton of iron. He obtained some of his coal requirements from Round Oak; the distance from Round Oak to his works was 6 miles 51 chains, and the combined rate (both the GWR and LNWR lines had to be used) was 1/10 a ton without wagons. At the time

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(33) Select Committee on Railways, 1881, M.E. 14,380.

of the 1881 enquiry he had tried and failed to obtain a reduction from the companies:

"On applying to the railway companies who were interested, I was told that there was a private arrangement between the London and North Western and the Great Western, whereby the discharging company should take 1/- a ton, whatever distance the company might carry the material, that is to say, that the discharging company, if it only carried the material 100 yards, would take 1/- a ton for it; and that being so, we could not get the rate reduced because the discharging company, taking 1/-, the Great Western Company were not willing to take less than 10d.."

(34)

Perhaps in part to illustrate the confusion which sometimes surrounded the local railway system, Hickman proceeded to tell the Select Committee that he did not, in fact, pay the 1/10:

"I found that the London and North Western Railway have a local rate of 9d. from Dudley, which is the point of junction, and so by carrying the coal to Dudley, and re-consigning it from Dudley to Deepfields, we got the Great Western Company's rate of 9d. making 1/7 instead of 1/10".

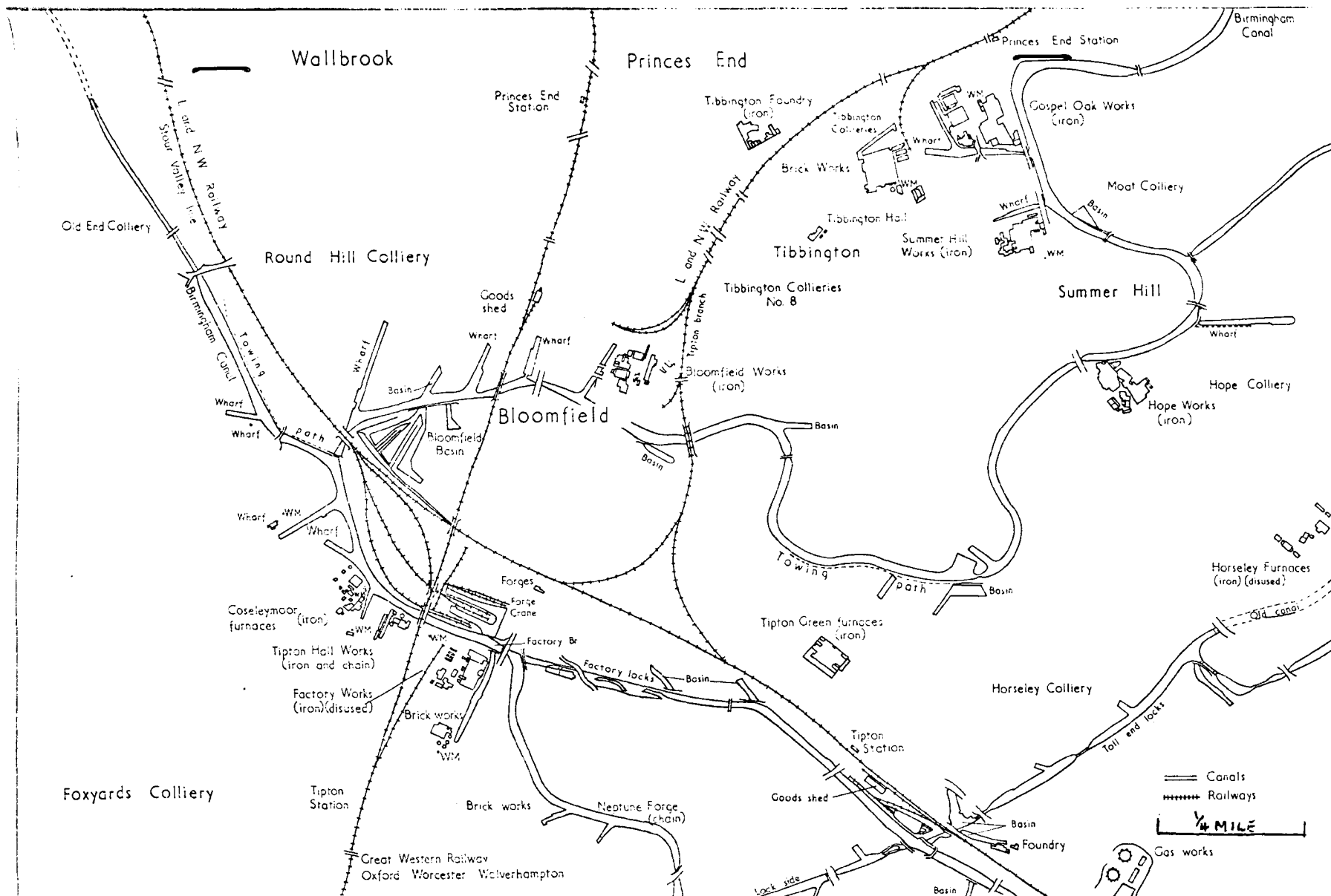
(35)

He alleged that in the days before the Stour Valley Railway had been taken over by the LNWR the maximum rate permitted by parliament had been 1d. a ton a mile (for truck loads) and that on the West Midland Railway the journey had been done for 1/-, "being 6d. for carriage and 6d. for wagons". Grierson, for the railway interests, explained away Hickman's allegations of "overcharging" in a statement which goes some way towards illustrating the sharp differences of approach taken by the two sides in the legality of rates charged:

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(34) Select Committee on Railways, 1881, M.E. 4339.

(35) Ibid, M.E. 4340.



Map 10. CANAL RAILWAY BASIN, 1889

"Dealing with the rate for coal from Round Oak to Deepfields, it has already been explained that the rate from Round Oak to Dudley is 9d., and not 10d., per ton, and that this is for a minimum distance of six miles, in lieu of the actual distance of two miles and 49 chains. The London and North Western part of the charge, 9d., is presumably within their powers. This makes the rate throughout  $1/6$ , and not  $1/7$ , in owner's wagons, as stated by Mr. Hickman. In estimating the total maximum legal charge he appeared to have ignored the minimum mileage charge applicable to each company, and, therefore, the excess of charge which he puts at  $1/5\frac{1}{2}$ d. falls to the ground".(36)

Whenever the issue came under discussion, the railway companies could argue the case of "minimum mileage charges"; even over such a short distance as the journey in question two companies were involved and each could make the charge. Terminal charges, handling charges, toll charges - the company could select the material to justify the rates from any number of such points. Hickman knew, for example, that at the Bloomfield Basin of the LNWR (37), the cost of dispatching and discharging goods by the company was 2d. per ton - this amounted to marshalling the wagons at one end and shunting them at the other. The railway company charged customers like himself between 10d. and 1/- per ton. Hickman was further exasperated over the fact that the railway companies refused to give a reduction to those ironmasters or colliers who had built their own sidings:

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(36) Select Committee on Railways, 1881, M.E. 12,705.

(37) See Appendix 2 for a full list of the railway-canal basins in and around the Black Country. The railway companies were also in the habit of charging for terminals on canal traffic whereas, in fact, they did not exist.( Ibid, M.E. 12,539).

"I have in vain argued that a man who has gone to the outlay of making a siding, which saves expense to the railway company, and who has gone to the expense of locomotive power to shunt and marshall the trains, should be benefited by the outlay, which the railway company saves. Of course, it is obvious that when a train goes into a large station and has to be led out to discharge the waggons into boats, if the waggons are not in place when the boat is, the waggons must be moved, and if the boat is not there they must keep moving the waggons about in all sorts of ways until the boat arrives...". (38)

Railway companies, in fact, did not have sidings; they simply put in a pair of points and the blast furnaces connected with them. One ironmaster from the Dudley area had spent £5,000 on railway sidings only to be told by the railway company that they would have to charge him "2d. more per ton for running the ore into the sidings" than if they had taken the ore to the nearest station. He argued that "but for the sidings belonging to the various companies in the district the railway companies would not have been able to accommodate half the traffic". (39) The railways pointed out that the Dudley ironmaster would have spent more on boating the ore from the station to his works.

Another area from which ironmasters in the Bilston-Wolverhampton district obtained coal supplies was Cannock. On the evidence of the manager of the Cannock Chase Company, J.N. Brown, the railways "overcharged" by 33 per cent to Wolverhampton and 60 per cent to Bilston.

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(38) Select Committee on Railways, 1881, M.E. 4429. It is interesting to note that on 4 December 1884, Hickman made an agreement with the GWR whereby, in return for his permission for the railway company to build two bridges over part of his land, the company lent him second-hand sleepers and rails with which to build a siding. (Deeds in possession of BSC).

(39) Select Committee on Railways, 1881, M.E. 5547.

With regard to the local mineral traffic, be it the carriage of iron ore, coal or limestone, what was really at issue was whether or not the railways wanted the traffic in the first place. It was, indeed, a far cry from 1845 and the promises of the railway company that they would build lines exclusively for this traffic. Hickman was obviously quite mistaken in thinking that his custom could be of value to the Great Western; he argued that if the rate from Round Oak to Deepfields had been 0.5d. per ton per mile he himself would have increased the traffic from "240 tons once in a month or six weeks" to "two train loads a day", and that this would have given the railway company £42 a week instead of £19 a month. Grierson, with unusual frankness, commented that "the traffic would not be worth carrying; it would have, and must have, the effect of blocking our main line, for the traffic would have to pass upon a very heavy incline (the Dudley Bank), and the rate would be too low to block our main line for it". (40) Grierson concluded: "... there are cases in which we can make low rates to encourage traffic, but this is not one of them". (41)

Hickman, it must be admitted, was especially concerned over the alleged high freight charges on the mineral traffic because his works at Spring Vale were integrated, that is, he possessed blast furnaces, puddling furnaces (after 1884 these were replaced with steel-making plant) and rolling mills. He was less concerned over the freight charges on pig iron: "Some of the railway rates on pig iron are excessive, but they are of

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(40) Select Committee on Railways, 1881, M.E. 12,838.

(41) Despite Grierson's views, Hickman was, in fact, able to get a reduction on the rate from 1/6 to 1/- from both Cradley and Round Oak to Deepfields on the promise that he would receive full train loads of 150 tons a day.

of small importance compared with the excess on the raw materials". (42) By this time, South Staffordshire had ceased to be a noted exporter of pig iron, although it received pig iron from all the major producing districts in the country. It was Hickman's contention that given what he called a fair railway rate (0.5d. per ton per mile) the local district could produce pig iron as cheaply as anywhere else, including the Cleveland area. Staffordshire cinder pig was sold locally for 35/-, whilst common foundry pig cost between 37/6 and 40/- a ton to produce. Similar pig iron from Middlesbrough cost approximately 38/-, plus carriage of 12/- per ton. In such circumstances, it was not surprising that Hickman told the Select Committee that Middlesbrough pig imports had "declined as of late". To illustrate what he chose to call "the apparent perversity of railway companies", Hickman informed the Select Committee of the LNWR's pattern of charges for the carriage of pig iron to various centres within the Black Country. Pig iron coming from Dowlais reached Wolverhampton first and the charge was 9/2 per ton; the next station, which was Bloomfield, the charge was 8/4:

"When they get to Bloomfield their line stops; they do not go any further than Bloomfield but they deliver at Stourbridge, to get to which place they tranship the iron and boat it, and they charge to

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(42) Select Committee on Railways, 1881, M.E. 4312. Hickman claimed that the railway companies were overcharging for pig iron on the journey from Deepfields to Monument Lane Station (Birmingham), a distance of 9 miles and 2 chains (2/6 instead of 1/3<sup>3</sup>/<sub>4</sub>d.), and to Brettell Lane (West Midland) a distance of 7 miles and 72 chains (2/11 instead of 1/2). Once again, two railway companies were involved, each claiming its minimum mileage charge and terminal charges.

Stourbridge 7/6". (43)

In fact, Hickman was well aware of the reason for this strange state of affairs - competition arising from the fact that the two companies concerned - LNWR and GWR - brought the Dowlais iron into the district by two entirely different routes. The former company took a longer route, leaving South Wales by Abergavenny Junction, then northward to Shrewsbury, via Leominster, Craven Arms and Church Stretton, before turning south-east to Stafford and then on to Wolverhampton. The Great Western left Dowlais by the Tafbargoed Valley line to Pontypool Road, and then through Hereford, Worcester, Kidderminster and on to Stourbridge.

Perhaps inevitably, by 1881 many local ironmasters in the Black Country were keen to show that their district was labouring under unfair freight rates in comparison with the other iron producing districts of the country. For the first time, too, although Hickman admitted that he then knew little about them, a fair amount of interest was shown in both American and Continental rates. In looking at the situation with regard to the other British areas, a number of general principles can be noted. Firstly, where an area, like the Black Country, was served by more than one railway company, it was extremely difficult for the manufacturers to obtain reductions. Indeed, it was preferable for an area to be served by only one railway. Mention has already been made of the fact that the three companies serving the Black Country did not permit competition to take place which could lead to lower freight charges. Hickman stressed this fact: "The competition is set aside by combination; they are all agreed to be bound by certain fixed regulations which they all carry out, and never depart from". (44) On another occasion, he quoted what Mr. Moon, chairman of the LNWR, had told a South Staffordshire deputation following complaints

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(43) Select Committee on Railways, 1881, M.E. 4456.

(44) Ibid, M.E. 4528.



about the rate to Liverpool from Staffordshire. Moon said: "It is your own fault: you, the leaders of South Staffordshire have yourselves to blame. When we alone served South Staffordshire we were the only company carrying to Liverpool, our rates were 25 per cent less than they are now". (45) Again, too, there were occasions when local manufacturers had approached one or other of the railway companies to see if they could get some temporary concessions to try and develop (even open up) a particular market. Always the answer was no, because although one railway company would have benefited from the new traffic, one or both of the others would not give their consent because either they would "not have shared in the traffic thus assisted", or "it might have competed disadvantageously with other traffic in which they were interested". (46) Not surprisingly, Hickman went so far as to say to the Select Committee: "I think if all the railways were in the hands of one management; if for instance they were in the hands of the Government, we should be far better off". (47) This was not the first time in the area that hints at nationalisation of the railways had been made. By contrast, in the case of the Cleveland area, Sir Lowthian Bell had found that the North Eastern Railway Company served the local ironmasters to their general satisfaction. (48)

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(45) Mr. Moon was almost certainly referring to the fact that his company lost control of the Shrewsbury and Birmingham Railway in 1851, when the directors of that company decided to throw in their hand with the GWR. The Shrewsbury and Chester Railway did the same, and in 1854 a through route was completed when an extension was made to Birkenhead Docks. At the time, it would seem to be in the interests of the local ironmasters to have two routes to Liverpool at their disposal.

(46) Report on Railways, 1909, M.E. 3984. The three companies which served the Black Country area between them owned 3,965 miles of track in 1872 and 6,345 miles in 1911. They had to be careful to view their operations over the whole country and weigh up the effects on other producing areas if they gave freight advantages to a particular region, (Report on Rail-

An arrangement had been worked out whereby freight charges were lowered on iron ore and other raw materials when trade was bad, and to raise them during boom periods. Furthermore, to try and encourage the industry to pick up again in 1884, a reduction of  $1/3$  per ton was made on pig iron carried into the South Staffordshire district. It was hoped in Middlesbrough "that the alterations may lead to a larger demand from that part of the country". (49)

The second point to make is that where the railway companies had to face competition from coastal shipping their rates were decidedly lower. Both South Staffordshire and the South Yorkshire area were 'victims' of this state of affairs. For example, bar iron from Dudley to London, a distance of 126 miles, was carried at 15/- per ton, or 1.43d. per ton per mile, whereas the same product went from Cardiff to London, a distance of 170 miles, for 12/6, or .88d. per ton per mile. Hingley was sure that this was because the railways faced competition from the sea in the case of Cardiff. (50) Local manufacturers were equally sure that such variations in freight charges had been sufficient to cause the area to lose out in galvanizing and sheet-iron and for a former Dudley manufacturer of cast-iron water pipes to open a foundry and blast furnaces in the Middlesbrough area. The slower rate of growth of the Black Country tin-plate industry, compared with South Wales, was also in part attributed

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ways, 1911, pp. 840 et seq.) In a sense, this fact made the 1863 railway agreement doubly significant (and harsh) for the local area.

(47) Select Committee on Railways, 1881, M.E. 4531.

(48) This was not always to be the case. In 1897, Cleveland ironmasters complained of unfair railway rates to ports on the West coast of England, and in 1909, Burton, the managing director of the Tees Iron Company, complained of high rates due to the fact that the North-Eastern had "got it all its own way". Report on Railways, 1909, M.E. 4072-74.

(49) Iron, 29/8/84.

(50) Select Committee on Railways, 1881, M.E. 5503-5506.

Freight Rates on Bar Iron and Tin Plate

<u>Journey</u>	<u>Distance</u> (miles)	<u>Rate per ton</u>	<u>Rate per ton</u> <u>per mile</u>
<u>Bar Iron</u>			
Cardiff to London	170	12/6	.88d.
Dudley to London	126	15/-	1.43d.
Middles. to Hull	85	5/6	.70d.
Dudley to Hull	140	15/-	1.30d.
Middles. to Liverpool	155	8/9	.68d.
W/ton. to Liverpool	97 $\frac{1}{2}$	10/6	1.23d.
<u>Tin Plate</u>			
Llanelly to London	226	18/4	
Swansea to London	216	17/6	
Cookley (Kidd.) to Lon.	148	17/6	
Llanelly to Liverpool	187	12/6	
Swansea to Liverpool	192	12/6	
Cookley to Liverpool	108	12/6	
Llanelly to S/ton.	232	16/8	
Cookley to S/ton.	158	21/8	(51)

to the favourable railway rates to Liverpool and London given to the South Wales district.(52) The Midland Railway carried iron from Staveley to London (149 miles) cheaper than it was carried from Birmingham, on the grounds that Staveley largely produced iron pipes and was thus greatly in competition with Middlesbrough whose sea freight to London was only 6/6 per ton (53).

The third point to bear in mind was that the larger companies in any district were more likely to obtain concessions from the railway companies than the smaller producers. It has already been pointed out that Hickman obtained reductions in his coal shipments; it was generally thought that "big firms like Nettlefolds and Sir Alfred Hickman (could) take care of themselves, but the small man cannot".(54) William Menelaus, of Dowlais, had no need to turn to the Railway Commissioners for help - "We are strong enough

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(51) Select Committee on Railways, 1881, material taken from pp. 273 - 274.

(52) Ibid, M.E. 5807 - 9.

(53) Royal Commission on Depression ... , 1886, 3rd. Report, M.E. 12,540.

(54) Report of Departmental Commission on Railway Agreements and Amalgamations, 1911, M.E. 5806.

to fight the railway companies ourselves" was his comment to the Select Committee.(55) A much different fate, however, befell the Chatterley Iron Company when it took the North Staffordshire Railway Company before the Railway Commissioners and obtained a favourable decision. The railway company simply refused to carry for them at all, and when they were placed under a penalty of £50 per day by the Commissioners whilst they maintained that attitude, the railway company retaliated by sending trains at inconvenient times or permitted a build-up of the ironworks' wagons. The Chatterley Iron Company were finally brought to heel when the railway company told them to pull down a bridge which passed over, before connecting with, the main railway line. It was generally agreed, too, that it was far too costly for the smaller companies to bring an action before the Railway Commissioners.

The iron trade, in 1881, was fortunate in having J.S. Jeans to give evidence before the Select Committee. Not only did he have a thorough knowledge of the British industry as a whole, but he was also one of the first members of that industry to weigh up developments on an international scale. He showed to the Select Committee just how important the carriage of the raw materials for the iron industry was as a source of revenue for the railway companies. In 1880, for example, the railway companies together had been paid a sum of £4,406,051 for moving fuel, ore and flux to the blast furnaces for the manufacture of pig iron, at an average rate per ton of pig iron of 5/-,  $4/11\frac{1}{2}$  and  $11/4$  respectively.(56) On a rough calculation, this had amounted to between sixteen and nineteen per cent of the realised value of the pig iron made in 1880. What was interesting, in view of Sir Lowthian Bell's evidence a few years later

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(55) Select Committee on Railways, 1881, M.E. 1304-7, et seq.

(56) Ibid, M.E. 8831.

to the Royal Commission, was Jeans' further evidence in 1881 that the

<u>Average Rates per ton per mile</u>	<u>UK</u>	<u>USA</u>	<u>Germany</u>
Fuel	.	0.55d.	0.96d.
Ore	1.19d.	0.51d.	0.51d.
Pig Iron	1.20d.	0.70d.	0.66d.
Finished Iron	1.63d.	0.70d.	0.72d.

United Kingdom rates were higher than the rates of the chief iron-producing countries after Britain by "116% for iron ore, 60% for pig iron, 109% for other iron, and 98% for steel rails, the average of the whole being about 94%". (57) According to Jeans, the average cost per ton of pig iron for the conveyance of raw materials in the United Kingdom was 10/10.9d.; if the average Continental rate had applied it would have amounted to 5/2. (58) Like so many other commentators on the railway scene, Jeans, when he wanted to illustrate the absence of any "guiding principle in determining rates", found it easy to select examples from the Black Country. From Round Oak to London, the carriage on pig iron was 10/10 a ton; to Liverpool the carriage was 10/-. The carriage on finished iron to London was 15/-, whilst to Liverpool it was 11/-. Finally, <sup>J</sup>Jeans was one of the first spokesmen to mention the fact that whereas in the United States, for example, freight reductions of over 50 per cent in the last ten years had been realised, in Britain there had been no reductions whatsoever, and, in some cases, increases had occurred. (59)

Although Hickman had admitted in 1881 that he knew little of Continental freight rates, other representatives of the iron trade of the Black Country were more forthcoming on this subject. As was to be increasingly the case,

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(57) Select Committee on Railways, 1881, M.E. 8869.

(58) Bell's figures for 1886 differ greatly from this estimate. He gave the following to the 1886 Royal Commission: Cleveland (7/- to 8/-); South Wales (3/3 to 4/-); Scotland (4/2 to 5/-); Cumberland and Lancashire (10/-); Lincolnshire (7/6); South Staffordshire (7/- to 12/6).

(59) Select Committee on Railways, 1881, M.E. 8935.

it was in those areas of trade where foreign competition was beginning to hurt that the loudest voices were raised about high freight rates. Representing the galvanized iron trade of Birmingham and South Staffordshire, P. Heathfield gave evidence before the 1881 Committee and stated that local manufacturers were having to fight competition from both Belgium and Germany in markets as far away as Australia.(60) Their export performance was undoubtedly being held back because of the high railway charges to London and Liverpool. D.J. Kempson, a partner in the Birmingham firm of Thomas and Leonard Jenkins, iron and steel-wire manufacturers, complained bitterly of "100's and 100's of tons" of wire coming from Belgium on to the Birmingham market and selling at 8/6 per cwt. delivered, at a time when the list price for the local product was 10/-.(61) To Kempson the reason for this was simple; bright iron wire was carried to London for 28/4 per ton, whereas Belgian wire came all the way to Birmingham from Antwerp/Rotterdam, via London, for 16/8. Under cross-examination, it was explained to Kempson that perhaps the real cause of his troubles was the fact that the Belgian manufacturers could produce the wire more cheaply. Kempson was told by a member of the Select Committee:

"... you do not pay any charge upon your Birmingham wire in Birmingham; the Belgian wire is no doubt charged with a railway rate, but the Birmingham wire has not seen a railway yet; do I understand you to say that the Belgian wire, with the addition of the freight to London, and the railway rate from London to Birmingham, is cheaper in Birmingham than Birmingham wire? Yes - it is cheaper".(62)

Kempson's agreement must have appeared tame to the Select Committee, whereas, in one sense, he was right. Earlier in his evidence, Kempson had come closer to the fact that the Belgians' production costs were

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(60) Select Committee on Railways, 1881, M.E. 10,763.

(61) Ibid, M.E. 11,547.

(62) Ibid, M.E. 11,566.

lower because of the longer runs in production they were able to obtain through meeting very largely the needs of the London market. Exactly why were the Belgians able to obtain a rate of 16/8 for a distance of 313 miles, when the Birmingham manufacturer had to pay a much higher figure for 113 miles? This aspect of the railway rates issue was to trouble Black Country and Sheffield spokesmen on every occasion when evidence was called for by parliamentary bodies. (63) The practice arose, in fact, of charging low sea freight from the main Continental ports, notably Antwerp and Rotterdam, because otherwise the ships would have come back in ballast. (64) In the case of the actual journey on the railways, it was becoming customary by 1881 (and firm practice by 1900) for the railways to grant lower rates than the ordinary local rates for the carriage of goods for export, "but in order to comply with the law as to undue preference, the same rate must also be charged on goods imported into the United Kingdom". (65) This was cold comfort to the Black Country manufacturer, although one member of the 1881 Select Committee did point out that Birmingham nail manufacturers were able to benefit from the fact that low rates were being quoted from Antwerp to Birmingham "for the iron rods whence the wire is

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(63) See the 1911 Report, M.E. 5911 and 8135 - 41; also Appendix xix of the same report, p. 849.

(64) In 1911, it is worth noting that the sea freight for the same journey on goods going from Britain was appreciably higher than that on goods coming into the country. In the case of iron and steel class C goods (including Bessemer steel), it was 7/6 per ton outwards and 4/6 inwards; in the case of hardware the charges were 15/- and 13/- respectively.

(65) "... goods, such as hardware, imported, say, in London, are carried to inland towns at lower rates per ton mile than such goods would be charged, say, from Birmingham to the same town..." 1911 Report, M.E. 5911.

drawn".(66)

The Black Country obtained nothing from the workings of the 1881 Select Committee, and Alfred Hickman determined on other courses of action. By now he had become the leading spokesman in the district on the question of freight rates. As Chairman of the Wolverhampton Chamber of Commerce, he endeavoured, in 1883 and 1884, to get the railway companies to reduce their rates on traffic affecting the Midlands. A Standing Joint Committee on Railway Matters, comprising representatives from the major iron centres in the district, was set up and in early 1884 the trade press spoke hopefully of the chances of a newly-created South Staffordshire Railway and Canal Freighters' Association with its headquarters in Wolverhampton. (67) Virtually no progress had been made when, in 1885-6, the Royal Commission took a hard look at the effects of railway charges on the economy as a whole. In answer to question 10 of a circular sent out to Chambers of Commerce by the Royal Commission (68), the Wolverhampton Chamber of Commerce unhesitatingly replied: "The most important circumstance affecting the trade of this district is the unfair, unequal, and excessive railway rates which are charged upon all its productions". In February 1886, Hickman

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(66) Select Committee on Railways, 1881, M.E. 15,461-3-6.

(67) Iron, 22/2/84.

(68) Q.10. "Are there any special circumstances affecting your area to which the existing condition of trade and industry there can be attributed?"  
 A. "The most important circumstance affecting the trade of this district is the unfair, unequal, and excessive railway rates which are charged upon all its productions. Being an inland district all its manufactures have to go away by railway or canal, and obtaining its supplies of raw material to a large extent from a distance, it is entirely dependent upon its means of communication. The rates charged are excessive, as compared with either those obtaining in any other district in the United Kingdom, or in Europe or in America..." (Material in the possession of the local Chamber of Commerce, Wolverhampton).



was a prominent speaker at a Special General Meeting held by the Wolverhampton Chamber of Commerce on the subject of foreign competition. He was convinced that at the root of most of the district's ills were the heavy freight charges. Since his appearance before the 1881 Committee, when he had, indeed, to admit his ignorance of foreign rates, Hickman had made a thorough investigation of Continental canal and railway rates. Speaking of the local canal rates in comparison with those then prevailing on any of the French and German canals, he said:

"The rates now charged on the French canals for haulage, toll and all expenses averaged about  $\frac{1}{4}$ d. per ton per mile, and on the German canals the rate was less than  $\frac{1}{8}$ d. as compared to this district, where the raw material was charged for tollage alone  $1\frac{1}{8}$ d. per mile.." (69)

Hickman further pointed out that in England they had to pay twelve times as much for toll on certain material on the Birmingham Canal as the Germans had to pay for carriage including toll.

Alfred Hickman was the obvious choice to present evidence on behalf of the Black Country iron and steel industry to the Royal Commission. (70) Between 1881 and 1886, Hickman held that railway rates had become even "more oppressive", in as much "as the price of iron and materials have been lowered". (71) In 1873, the cost of freight from the Birmingham district to London had amounted to one-sixteenth of the price of the goods, whereas in 1886 it amounted to between one-sixth and one-eighth. He severely

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(69) Minutes Book, entry for 5 February 1886.

(70) He appeared before the Commission as a member of the Council of the Mining Association of Great Britain, of the Associated Chambers of Commerce, of the South Staffordshire Ironmasters' Association, of the Wolverhampton Chamber of Commerce and as Chairman of the South Staffordshire and East Worcestershire Freighters' Association.

(71) Report of the Royal Commission, 1886, M.E. 12,505.

criticised the railway companies for allegedly making up their losses which they incurred on the passenger traffic by raising the charges on goods carriage.(72) The railway companies engaged in too much competition with regard to attracting passenger traffic; he gave an example of the number of trains running between Birmingham and London - "no less than 56 trains run every day, 28 trains each way". On another occasion, Hickman had stated that the number of trains running each day between Wolverhampton and London - "48 trains, besides 28 others on the Midland and West Midland" - amounted to "gross mismanagement". He gave as a further example the number of trains which ran each day between London and Glasgow - "15 each way each costing the railway company about £60".(73) The failure of the last few years to get the railway companies to reduce their rates was to be seen in Hickman's wish to the Royal Commission that the Railway and Canal Commission would become a more active partner in the struggle for cheaper rates. Again, he wanted to see the Commission take more direct interest in the running of the canals, especially with respect to such things as through-rates between places having an unbroken line of communication over different canals. Hickman also made the point that whilst the South Staffordshire district had to pay at least  $1\frac{1}{2}$ d. per ton per mile on the canals, their French and Belgian competitors had an average canal rate of from  $\frac{1}{8}$ d. to  $\frac{1}{4}$ d. per ton per mile, a figure which included conveyance, "and provision of boats and every expense".

When Sir Lowthian Bell, by far the most prominent witness on behalf of the iron and steel industry to appear before the Royal Commission, gave his evidence, he took a different view with regard to railway rates and their

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(72) Report of the Royal Commission, 1886, M.E. 12,513.

(73) Minutes Book, entry for 13 November 1895. On that particular occasion, another Special Meeting of the Wolverhampton Chamber of Commerce, W.W. Walker went so far as to express the view that they "would be really better off if the railways were under State control". A Foreign Competition Committee was set up by the Chamber of Commerce.

influence on the industry. A little unfairly, he included Sir Bernhard Samuelson in his view that there was little to choose in the rates charged in the United Kingdom and on the Continent. His figures to the Royal Commission bore no relation to those given by Jeans in 1881; Bell tried to show what a particular journey in Britain would have cost in both Germany and Belgium. Even if we take his figures to be accurate, but they are, indeed, in sharp contrast with other 'independent' sets of figures, those relating to the iron trade of South Staffordshire show that in every case except Northamptonshire ore the South Staffordshire rate was appreciably higher than what a similar journey would have cost on the Continent.

<u>British Journey</u>	<u>Cost</u>	<u>German Equivalent</u>	<u>Belgian Equiv.</u>
Northants ore to Great Bridge (74)	3/2	3/3	3/8
Coke - S. Wales to Darlaston	7/3	6/10	4/7
Cleveland pig iron to Birmingham	11/3	7/10	6/2
Barrow pig iron to Birmingham	10/9	6/1	4/7
Kettering pig iron to Wolverhampton	5/10	3/11	3/6
Wellingboro' pig iron to Wolverhampton	5/10	3/11	3/9
Whitehaven pig iron to Tipton	11/8	7/11	5/3
Barrow pig iron to Tipton	10/6	6/7	4/9 (75)

From the findings of the Royal Commission it is clear that Bell's views on freight charges were accepted in preference to those pertaining to Hickman and others from inland centres of the iron trade.(76) Almost without exception, writers have since tended to dismiss the views of

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(74) In this case, Bell was probably thinking of the ore located on the south-west extremity of the field. It would be transported from Blisworth by the LNWR.

(75) Material selected from Bell's evidence, Appendix, part i, pp 345 et seq.

(76) The Final Report of the Royal Commission, pp. viii - ix, included a section on the iron and steel industry in which was written: "... Much stress was also laid on the cost of railway carriage as affecting the coal and iron trades".

Hickman and others, stating that they both exaggerated the levels of freight charges and that it was impossible to make a fair comparison between British and Continental charges because of the vastly differing situations which existed in the various countries. Nevertheless, it is worthwhile to look at the transport issue from a number of points, even if some old ground is re-covered, and the following aspects have been selected for examination:

- i. developments both in the United States and on the Continent between 1875 and 1913;
- ii. the various policies pursued by the transport lobby in the Black Country after 1886.

#### The United States.

Before an attentive audience in 1902, J.S. Jeans told members of the South Staffordshire Iron and Steel Institute that "the history of the American iron trade in the last thirty years is in no small part a history of transportation".(77) Andrew Carnegie would have agreed with him for in the next year, he told members of the British Iron and Steel Institute exactly what it meant in transportation terms for the American industry to sell "without loss hundreds of thousands of tons of 4-inch steel billets at 3 pounds for one penny" (62/3 per ton):

"To make that 3 pounds of steel, at least 10 pounds of material were required - 3 pounds of coke, mined and transported 60 miles to the works;  $1\frac{1}{2}$  pounds of lime, mined and transported 150 miles and  $4\frac{1}{2}$  pounds of ironstone, mined at Lake Superior and transported 900 miles to Pittsburgh, being transferred twice, once from cars into the ship, and again from the ship into the railway cars".(78)

In fact, the great distance through which raw materials had to be carried was the distinctive "feature of the American iron industry" in the last quarter of the nineteenth century.(79) From the early and middle 1860's,

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(77) Proc. S. Staffs., 1902-3, p. 43.

(78) J.I.S.I., ii, 1903, p. 9.

(79) H.H. Campbell, *op cit*, p. 441.

the railway companies had played an increasingly significant role in the development of the American industry; in some cases the railway companies could be said to have adopted a "forstering care" towards the industry, providing the credit etc. to site furnaces along a particular line.(80) By the early 1870's, when the then Mr. Lowthian Bell accepted an invitation to visit the ironworks of the United States, there were already 70,651 miles of railroad laid down there, compared with 16,082 miles in the United Kingdom.(81) A very important difference between the two countries concerned the cost of railway construction, £36,582 for the United Kingdom compared with £11,500 in the United States. However, as yet, railway rates were high in the United States - Bell put them at 1½d. per ton per mile for distances under 40 miles - and in the case of the leading ironworks in Pennsylvania the cost of bringing the ore, flux and fuel together was about twice the figure given for the Cleveland district.(82) Because of these high freight costs, and the variations in the quality and type of ore, until the late 1870's it was as cheap to take Spanish ores or British West Coast hematite to Pennsylvania. The State of Pennsylvania was itself, until 1880, "the heaviest producer of iron ore in the Union", although the quantity mined was insufficient to supply its blast furnaces.

With the discovery of vast supplies of ore in the Lake Superior area, it became of the greatest importance for the American iron and steel industry to meet the challenge of having to transport the ore over very long

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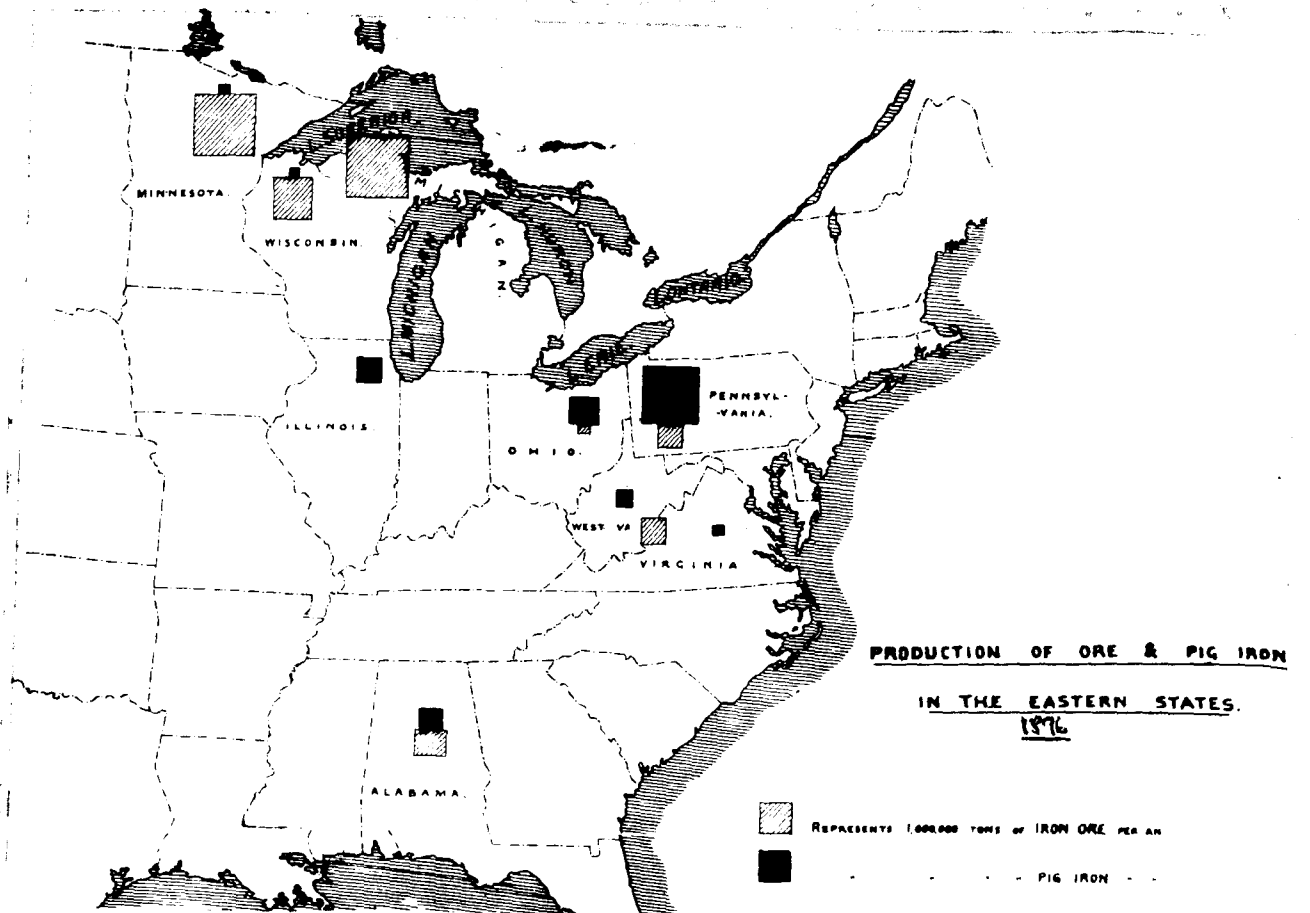
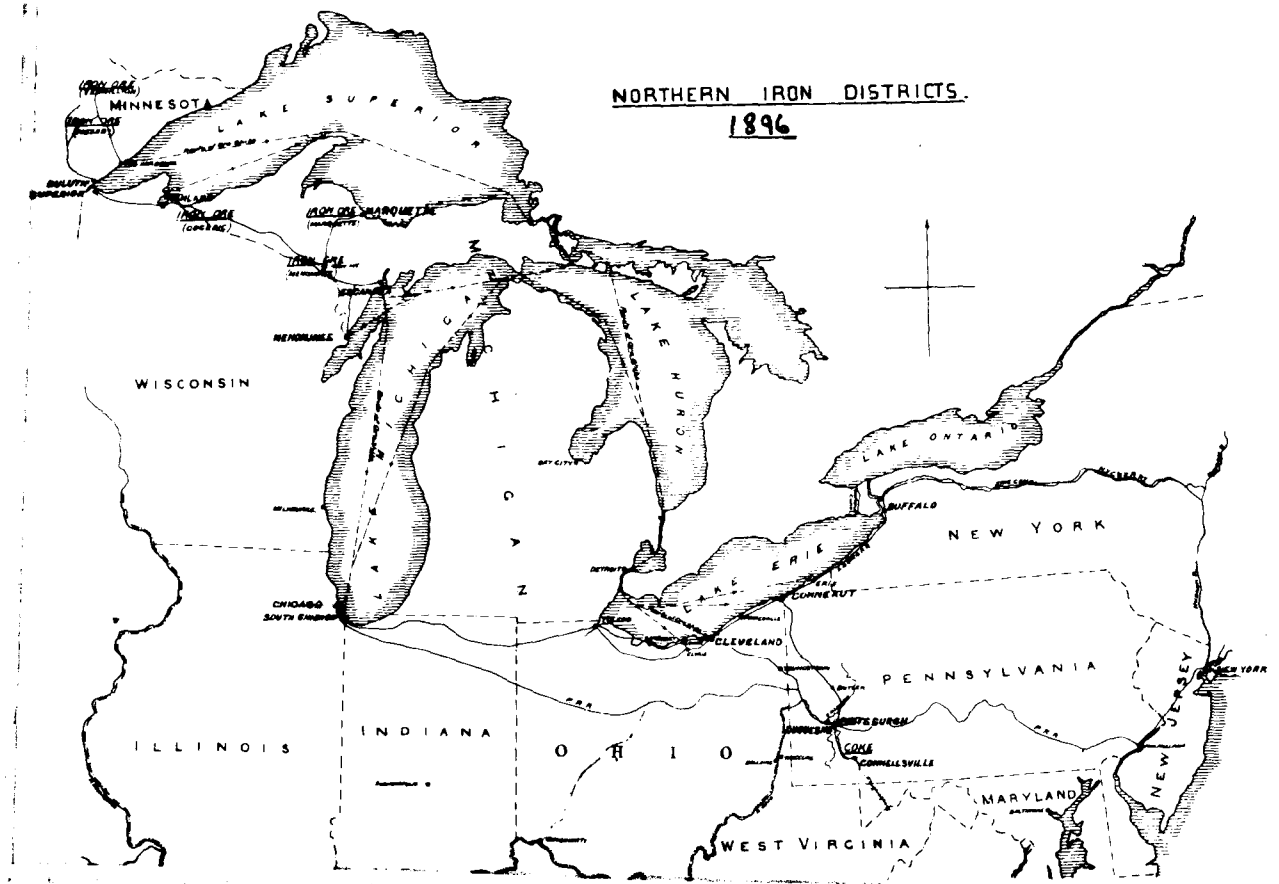
(80) J.I.S.I., ii, 1872, pp. 108 - 9, article by T.G. Smith of Philadelphia: "Western Development of Iron Manufacture in the United States".

Smith wrote: "Following the example of Reading Railroad, one of our western lines is offering to give in fee not only the land upon which to build a furnace, or a rolling mill, or a Bessemer steelworks, but also 100 acres of coal land upon which collieries can be cheaply and easily opened".

(81) Poor's Manual of American Railways, quoted by Bell, J.I.S.I., i, 1875, p. 83.

(82) J.I.S.I., i, 1875, p. 114.

Map 11.



Map 12.

and often difficult distances. The Marquette Range (Michigan), opened in 1845 but not extensively mined until a decade or so later, produced 155,722,000 tons of ore in the period 1854-1926. (83) In 1877, the Menominee Range (Michigan) was opened and the first shipments from Escanaba on Lake Michigan took place in 1880. By the following year, the output of iron ore of Michigan was the highest in the Union. In 1884, ore from the Gogebic Range, also in the north-west of Michigan, was sent east to Pennsylvania, Illinois and Ohio, and in the same year production started from the Vermilion Range in Minnesota. The great bulk of the Lake Superior

Iron Outputs of the Lake Superior Ranges.

Marquette (1854-1926)	155,722,000
Menominee (1877-1926)	152,544,000
Vermilion (1884-1926)	51,533,000
Gogebic (1884-1926)	160,547,000
Mesabi (1892-1926)	747,932,000

ore (see Maps 11 and 12), mined comparatively cheaply, was transported by rail to the ports and then by ship to ports on Lake Erie, notably Cleveland, the largest distributing centre on the Lake. The Lake journey varied from 750 to 900 miles, and in 1881 the contract rate on ore from Escanaba was 10/1½d. (£2.45c.) per ton. In 1897 and 1898, the same journey could be made for 1/10½d. (45c.), although the average price quoted in the two years 1898 and 1899 on the Lakes was 2/6 (60c.) per ton. (84) Freight rates on the Lakes were, in fact, subject to erratic fluctuations; nevertheless, they provided the iron and steel manufacturers of the Eastern States with the cheapest means of transporting iron ore in the world. From Cleveland, the ore was carried by rail to Pittsburgh and the Mahoning and Shenango Valleys. To save the cost of railway transport on the ore from Cleveland, the Illinois Steel Company built a large steelworks at Chicago, whilst the Johnson Steel Company chose Lorain on Lake Erie, just 24 miles to the west of Cleveland, as the most suitable site in the

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(83) ICTR, Jubilee Issue, 1927, p. 205.

(84) BITC Report, 1902, American Industrial Conditions and Competition, p. 105.

United States for pig iron production, that is, as near as possible to the Connellsville area for coke whilst maintaining the direct water link with the Lake Superior ores. It follows that both the Mahoning and Shenango Valleys, situated some 65 miles from Cleveland and 135 miles from the coke area, were not so well located as Lorain - if the assembly of the raw materials is taken as the chief locating factor. Pittsburgh, involving a journey of 150 miles for the ore and a 50 mile haul for the coke, was even less well situated; yet, Pittsburgh was the home of the Carnegie Steel Company, the leading iron and steel producer in the world. Apart from the organising genius of Carnegie himself, two factors made possible the continued hegemony of Pittsburgh. In 1892, the giant Mesabi Range (Minnesota) of iron ore was discovered; this was but two years after the visit to the United States of the British Iron and Steel Institute when Sir Lowthian Bell had gone on record as saying that Birmingham, Alabama, would dictate the price at which pig iron would be sold. Carnegie, on hearing of the ore discovery, was reported to have said that the ore would "have to be as cheap as dirt". By use of steam shovels - which made it commercially feasible to remove two tons of overburden to get one ton of ore - etc., the ore was <sup>as</sup> cheap as Carnegie wished for. In 1895, for example, "Mesabi ore ... sold ... f.o.b. Lake Erie docks, at \$2.50 per ton for Bessemer and \$1.75 for non-Bessemer, and for 1897 and 1898 ... at \$2.10 to \$2.15 for Bessemer and \$1.70 to \$1.80 for non-Bessemer..."(85) Carnegie already owned some of the largest and most modern ships on the Lakes; he now set about reducing the cost of the haul from the shore to Pittsburgh to the barest minimum by constructing what was probably the most effective, single purpose railroad system in the world, the Pittsburgh, Bessemer and Lake Erie Railroad. The railway connected Bessemer with the port of Conneaut, 156 miles away on Lake Erie; it was especially constructed for mineral

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(85) I.C.T.R., Jubilee Issue, 1927, p. 205.



traffic, "the working expenses being reduced to a minimum by having long and heavy trains of large cars drawn by powerful locomotives, all passenger traffic with its attendant complications and expenses being excluded".(86) The cost per ton per mile was little more than  $\frac{1}{8}$ d., in other words, only about one-eighth of the cheapest average ton-mile rate charged on the North-Eastern Railway, thought by Bell to be the most efficient railway serving a major iron and steel producing area in the United Kingdom. Even charging such low rates as those quoted to Jeans in 1901, the

Operational Facts of the Bessemer Railroad in 1900

Total Freight Traffic	4,180,391 tons (60% iron ore)
Gross Freight Receipts	\$2,112,860
Average Receipts per ton mile	0.20d.
" Length of Haul	121.78 miles
" Live Load per Train	868 tons
" Tonnage Carried per Loaded Wagon	37 tons

Bessemer Railroad was able to make a "handsome profit" (87), a fact which prompted Jeans to comment:

"When one thinks of the rates charged on British railways, as typified by the normal charge of 10/- to 12/- for the transport of pig or other metal from South Staffordshire to London, a distance of 120 miles, and by a charge of 7/6 for carrying a ton of coke from the South Durham coalfields to West Cumberland, an average distance of less than 100 miles, this American ore carrying line surely suggests great possibilities in the way of cheapening British mineral transportation in the future". (88)

Jeans and Bell were poles apart in their interpretation of the significance of American freight rates. Bell tended to pour scorn on the former's views, especially Jeans' belief that "American railways had

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(86) Proc. S. Staffs., 1987-8, p. 28.

(87) BITC 1902 Report, p. 95.

(88) Ibid, pp. 95 - 6.

attained a degree of economy to which our railways are strangers"(89); nevertheless, even Bell in 1890 had to admit that reductions of between 37 and 52 per cent had been made in the cost of the assemblage of raw materials over the fifteen years' interval between his visits to the United States.(90) He wrote in 1890 that information which he had received proved that freight rates on iron ore from the Lake ports to the pig iron producing districts of Ohio and Pennsylvania had been reduced from 0.791d. per ton per mile to 0.396d., and from 0.740d. to 0.360d. respectively in the decade from 1880 to 1889.(91) Rates for carrying coke had dropped to 0.650d. (60 mile journey) and .287d. (528 miles). The charge per mile for conveying steel rails over a distance of 479 miles per ton (2240 lbs.) had also gone down from 0.365d. in 1880 to 0.235d. in 1890. By 1900, similar reductions had again taken place; for example, coal was often carried for as little as 0.16d. per ton per mile on journeys of between 450 and 500 miles. The whole assemblage charge on a ton of pig iron made in Pittsburgh in 1901 was 8/4.

In looking for an answer (or answers) to explain just how freight rates in the United States were reduced so dramatically, Bell and Jeans, between them, give a full if often conflicting account. Bell accepted the

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(89) Bell's views can be found in the 1890 Special Volume on America published by the Iron and Steel Institute; those of Jeans in the BITC Report of 1902. Bell was correct in denying Jeans' view that the cheaper freight rates largely accounted for the growth of the American iron and steel industry. In every other point, however, Jeans was much nearer the truth, and he took delight in proving incorrect so many of Bell's prophecies. See 1902 Report, pp. 116 - 118.

(90) J.I.S.I., Special Volume, 1890, p. 48.

(91) *Ibid*, p. 49.

view of "an old friend of great experience in railway matters":

"First, The increase of capital, whereby competing lines have been established, which struggle for supremacy in tonnage, and cause great reductions in rates.

Second, The use of steel rails has enabled the companies to use much heavier locomotives, and thereby the cost of carriage has been greatly reduced.

Third, The improvements which have been made in the construction of steam-vessels upon the lakes of our northern border have greatly reduced the cost of transportation by water, which changes have compelled railroad companies to reduce rates to a corresponding extent". (92)

Jeans gave the following as the most important causes of the "Lower Range of American Rates and Charges":

"first, the cheaper cost of construction; second, the greater competition, owing to there being practically free trade in transportation; third, the less amount of handling done by the railway companies in relation to the length of haul; fourth, the stimulus to secure and develop traffic; and fifth, the economies in the conditions and cost of transport introduced within recent years. These are not submitted as the whole of the causes, but they are the most important". (93)

According to Jeans' figures the cost of construction in the United States was about one-quarter the English cost. Little or no "free trade in transportation" existed in Britain, with the result that there was but scant competition between the various railway companies. Rather than see any railway company go under in Britain, the amalgamation movement had of necessity entailed the absorption of unprofitable lines by the major companies. This was not the case in the United States where, partly as a result of "unrestricted competition" in the period 1876 to 1900, some

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(92) J.I.S.I., Special Volume, 1890, p. 50.

(93) BITC Report, 1902, p. 92.

634 companies, and representing "113,275 miles of line, and a total capital in bonds and stocks of \$6,388 $\frac{1}{4}$  million, went into the hands of receivers".

(94) A member of the 1881 Select Committee on Railways had the American situation very much in mind when he accused Hickman of wanting to destroy the railways:

"Do you not think that it may be just possible that in endeavouring to force upon the railway companies a rate which you chose to term fair, the ironmasters may also now not be looking far enough ahead, but may be ruining and crushing railway enterprise?" (95)

However, it did not follow automatically that low freight rates had caused the downfall of so many lines in the United States. Jeans commented:

"The railroads of the United States are ... built in advance of both population and traffic, and it depends largely on their staying powers whether they can be kept alive until they become self-supporting. The Pennsylvania Railroad, which quotes among the lowest rates known, even in the United States, has long been a prosperous exercise, and has demonstrated the possible co-existence of low rates and good dividends". (96)

Undoubtedly, the amount of handling in relation to the length of haul greatly favoured the Americans; with one or two exceptions, the length of haul in the United Kingdom did not exceed 35 miles, whereas in the United States it was approximately 112 miles. If a direct comparison is drawn between the Pennsylvania Railroad and the North-Eastern, then the former carried its traffic an average distance of 109 miles whilst the latter's average "was probably no more than 22 miles, or say about one-fifth of its great American competitor". (97) It is with regard to Jeans' fifth

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(94) BITC Report, 1902, p. 105.

(95) Select Committee on Railways, 1881, M.E. 4544.

(96) BITC Report, 1902, p. 105.

(97) Ibid, pp. 89 - 90.

point that the record of the British railways of the last twenty-five years of the nineteenth century compared most unfavourably with the main ones in the United States. In 1888, Jeans had argued, and had been severely taken to task by Bell, no doubt in his capacity as a director of the North-Eastern, that British railway managers would have been well-advised to visit the United States and see the improvements being made there. One of the most significant was the growth in size of railway wagons, a factor stressed by E.P. Martin in his Presidential Address to the Iron and Steel Institute in 1897. (98) With their larger wagons the American companies had greatly reduced their tare; Martin gave an example of the Taff Vale Railway Company increasing the size of its trucks to ten tons and then asked: "Why not 25 or 40 tons?" The 5-ton car (wagon) was used for mineral traffic in the United States in the 1860's but from that time onwards there was a steady increase in size, together with a decline in the deadweight. The 20-ton truck was introduced in 1876; the 25-ton in 1883; the 30-ton in 1885; the 40-ton in 1895 and the 50-ton by 1900. In terms of the enlargement of train-loads, on the New York Central the figure rose from 258 English tons in 1896-7 to 365 tons in 1900-01; on the Lake Shore Railway it advanced from 119 tons in 1872 to 224 in 1880, 238 in 1890, and 404 in 1900. On the Pennsylvania Line in 1900 the ton-load was 431; compared with these, the figure for the LNWR had been 59.4 tons in 1872, 65.6 in 1880 and 68.6 in 1900, but it was felt by many observers that the conservative approach of the Railway Clearing House had practically confined them to the use of 10-ton trucks. To pull the heavier loads in the United States, improved locomotives had been necessary, and this demand had been met by the Baldwin Locomotive Works which, by 1900, were producing freight locomotives of 100 tons (the standard American freight locomotives in 1870 had been 40 tons), Obviously, the longer

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(98) J.I.S.I., 1897, p. 37.

hauls characteristic of the American system would have necessitated more powerful engines, but another factor which was of considerable influence was the increased traffic on the railways. Greater intensity of traffic in the United Kingdom had resulted very largely in the railway companies wanting to cut back on their supposedly less profitable traffic (the point of issue between Hickman and the railway management); certainly, greater density of traffic did not lead to a lowering of freight rates as a result of improvements influencing running costs. The absence of larger trucks did lead, if only occasionally, to running difficulties in the Black Country. In December 1893, for example, a great demand for coal arose in the area; the LNWR was scarcely able to meet the heavy demand for wagons. The railway company was running 120 trains a day at the height of the coal shortage, each of them made up of between 20 and 40 trucks.(99) Between 1880 and 1900, the ton-mileage figures on the LNWR rose by nearly 30 per cent, yet the train-load increased by only 4.6 per cent.(100) Samuel Fry, manager of the Great Central Railway in 1900, was prepared to concede superiority to the Americans:

"Where the Americans are far superior to us is in the economical management of the freight traffic. This is the reason why they can show greater net earnings while charging lower freight rates and paying higher wages than our roads. One of the first things the English roads will have to do will be to get heavier and more powerful engines for freight traffic".(101)

At the end of 1901, the Pennsylvania Railroad and the North-Eastern company had the following rolling stock:

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(99) Colliery Guardian, 8/12/93.

(100) 1,194,078,000 tons in 1888 and 1,549,556,000 tons in 1900.

(101) Colliery Guardian, 23/11/01.

<u>Pennsylvania Railroad</u>		<u>North-Eastern Railway</u>	
Locomotives	1,889	2,121	
Passenger cars	1,779	2,884	
Goods and mineral cars	52,784	98,248	(102)

In each case, the English company possessed more equipment than its American counterpart, and yet the latter carried twice as much freight over a much greater area. It followed that the American equipment had to perform to higher standards than in Britain, but it also meant that each American locomotive handled "from six to ten times the quantity of paying traffic" of its British opposite. Initial capital outlay, maintenance, and labour costs all favoured the American company. Obviously, these major American developments could not have been introduced on all British routes; the fact is that before the First World War virtually nothing was achieved in this direction. As late as 1929, there were only 26,000 wagons of 20-ton capacity in use on British railways, a figure representing but three per cent of the total number of mineral wagons. A prominent economist wrote in the early 1900's:

"In England again the general introduction of the larger truck and longer train would prove very costly, since turn-tables, weigh-bridges, goods-yards with their sharp turnings and sidings - the number of which is legion on the British system, which reaches with its ramifications to the very doors of innumerable factories and warehouses - are accommodated to the small truck and short train".(103)

No matter how true this was it was the refusal of both industry and the railway companies as a whole in Britain to face such difficulties that was leading to the country becoming less and less competitive in international markets in the period prior to the First World War. Charles Schwab, then President of the United States Steel Corporation, told Jeans that "one of the chief causes of our not maintaining our place in the

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(102) BITE Report, 1902, p. 90.

(103) S. Chapman, Work and Wages and Foreign Competition, 1904, p. 281.

world's commerce was the defective character of our railway organisation, and the consequently high railway rates generally charged". (104) Carnegie's advice to the British railway companies had long been the same - "make a bonfire of their rolling stock generally".

#### The Continent.

Iron production in Germany was originally tied to the ore deposits, with the result that the industry was to be found chiefly among the hills and valleys on the Upper Rhine, in Upper Silesia and in the Harz Mountains. With the growing use of coke in the blast furnaces the industry tended to migrate towards the coalfields, especially towards the Ruhr district. This move presented the German industry with enormous transportation problems; in the first place the chief ore and coal deposits were now at considerable distances apart and, secondly, the native German ores were of low quality resulting in the need to transport even larger quantities of fuel for their reduction. Before the discovery of the basic process, too, Germany was compelled to import large quantities of hematite ore from Spain (as was Britain). As Bell pointed out to the Royal Commission it cost roughly the same amount of money to transport Spanish ore to either South Wales, the Middlesbrough district or Rotterdam; the Germans then had to pay a further 4/- per ton to carry the ore to their blast furnaces, with the result that "this item alone will make a ton of Bess-emer pig iron cost 8/- above what the same iron, in some cases, can be produced at furnaces on the Tyne or at Middlesbrough". (105) Even with the basic process making available the huge ore resources of German Lorraine and Luxembourg (the ore was very cheap and self-fluxing) there still remained some 250 miles between the ore and the Westphalian coke. Because it was more expensive to transport the ore to the coalfields, there was a tendency for the German industry to migrate a second time, and many

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(104) BITC Report, 1902, p. 87.

(105) Royal Commission on Depression of Trade, 1886, Appendix Bell's Evidence, p. 347.



of the leading works in Rhenish-Westphalia erected new blast furnaces and steelworks in Lorraine. A locational break-down of the industry in the years 1908-12 was as follows:

Rhineland-Westphalia.....	43%
German-Lorraine/Luxembourg.....	31%
Saar, Siegerland & Lahn districts and Hesse-Nassau.....	13%
Silesia.....	c.6%

In the same period, 66 per cent of the Lorraine-Luxembourg ore was consumed locally, whilst 13 per cent was sent to Westphalia and 11 per cent to the Saar. (106)

Even this brief account of the shifts in the location of the German industry will make it abundantly clear just how important it was for the industry to be served by good transport facilities. Fortunately, the Germans were able to take full advantage of excellent natural facilities for assembling the raw materials and distributing the finished product. The coalfields of Westphalia were intersected by the Rhine, into which flowed the Moselle from Lorraine. Furthermore, the Rhine was navigable by sea-going vessels (carrying 5,000 tons), and barges (carrying 2,000 tons) could go up to Mannheim. With the opening of the Ems-Dortmund Canal in 1899, cargoes of 900 tons could pass directly from the Rhine to the sea. Generally, the average barges on the German river and canal systems carried 600 tons, against the 300 on French canals and canalized rivers, and 30 tons on the English canals. (107) Indeed, the main difference between water transport facilities in Germany and those in England was the latter's absence of navigable rivers ("to which canals are merely adjuncts"). Of the total length of navigable waterways in Great Britain, less than 27 per cent consisted of rivers, as against 92 per cent in

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(106) Parliamentary Papers 1913, No. 285, Iron and Steel, 1912, p.27.

(107) Harbord and Hall, op cit, pp. 519 - 20.

Germany.(108) A further important difference concerned the average rise per mile on the waterways, important because of the great difference in the cost of locks per mile of waterway. On the English canals, the average rise per mile was 10.8 feet, compared with 1.5 feet on the continent, or just over seven times as much.(109) Apart from a brief spell after 1840, when railroad construction tended to divert capital and attention from the waterways, continued efforts were made to improve water transport facilities. Hard upon unification in 1871 came a policy of creating a coordinated transport system out of the railroads, rivers and canals; as a result of a large expenditure of capital, by 1903 Germany had almost 9,000 miles of navigable waterway. Much of the shallow "cuts" of earlier decades had been turned into wider and deeper canals. Not surprising, therefore, that water freight rates were lower in Germany than in England, but Hickman was fully justified in complaining of the fact that the Black Country ironmasters had to pay eight times the rates charged on raw materials in Germany.

Important though the waterways were to the German economy, the development of an excellent railway system was even more significant:

"Hindered hitherto by a short coast line, by the northern flow of her rivers and by the freezing of her canals in winter, she gained new outlets East, West and South at all times of the year. She became a Mediterranean power by the completion of the railway over the St. Gotthard in 1882. She obtained great economic influence in North Italy and Genoa became an important German outlet. In the same way the railway

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(108) 62% of the waterways in France were navigable rivers.

(109) Two extreme cases - from Birmingham to the Bristol Channel, a distance of 72 miles, there were no fewer than 62 locks, 5 tunnels and 115 bridges; from Berlin to Hamburg, a distance of 230 miles, there were only 3 locks.

to Constantinople made her a power in the Balkans with commercial interests in the Levant. She was connected by railway with France on the West and Russia on the East and became the centre of the continental system of distribution, thereby affecting the hitherto unrivalled sea distributing position of England".(110)

Before 1871, some 12,000 miles of track had been put down by some 70 state governments or private companies in the area of the new German Empire. Generally, the builders of the German railroads had tended to follow the American, rather than the British, pattern of cheapness in construction and operation, a result of which was that the cost per mile of railroad was only £20,275. Although Bismarck failed to create an Imperial Railway system, public ownership of the greater part of the railways enabled Germany to fit them more neatly into an overall economic policy. In a sense, the iron and steel interests benefited from the fact that the states, not the Empire, owned the railways because individual State Ministers were willing to promote exports through offering preferential rates; in 1893 and 1897 special reductions were made on the carriage of iron and steel goods which amounted to export bounties. Officially, preferential rates were described as "applicable to agricultural and industrial products, and intended to assist and facilitate import and export, and increase the traffic of the country"; in the case of iron and steel goods for export preferential rates were the rule rather than the exception. It would be quite incorrect, however, to give the impression, as some English observers did at the time, that the German railways were a further form of state subsidy to either the iron and steel industry or to German industry as a whole; running losses were incurred, but, in 1911 for example, after all working and capital costs had been met, the railways showed a total

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(110) L.C.A. Knowles, The Industrial and Commercial Revolutions in Great Britain during the Nineteenth Century, 1930, p. 187.

surplus of £90,000,000.

It was clear from the evidence presented to the 1881 Select Committee that Germany's cheaper freight rates were causing concern amongst English industrialists. Bell might choose to deny the fact, both in 1881 and in 1886 at the time of the Royal Commission when he estimated that Rhenish and Westphalian works were 15/- a ton of pig iron "worse situated than the English and Welsh works for carrying on a foreign trade" (111), but the cheaper freight rates available to the Germans enabled firms in Oberhausen, Dortmund and Ruhrort - more than 120 miles from the nearest tide-water - to compete with British works situated upon or within a few miles of the sea. In 1880-81, for example, it cost Sheffield hardware producers 22/6 per ton to convey their goods to either Hull, West Hartlepool or Newcastle (Tyne Dock) for export. This amounted to a rate per ton per mile of between 2.061d. (Newcastle) to 4.655d. (Hull). On various steel goods, the rate per ton per mile to all three ports was 1.374d. to 3.103d., the through rate per ton averaging out at 15/-. From Essen, to either Amsterdam or Rotterdam, the rate per ton for hardware was 8/4.800d., or from 0.760d. to 0.822d. per ton per mile. Equally much lower rates were charged on a whole range of iron and steel goods. (112) A further sign that German iron and steel goods were threatening former British markets can be seen in the growing number of consular reports which contained reference to German competition. Many of the European-based consuls linked this fact to the excellent transport facilities available to German exporters - the fact that Germany could get her goods into European markets "at the cost of one handling and one train journey at very cheap rates". The BITA Report of 1896 on the German and Belgian industries stressed the value of the cheap transport rates; from figures quoted in the report

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(111) Royal Commission on Depression of Trade, 1886, Appendix Bell's evidence, p. 348.

(112) Select Committee on Railways, 1881, pp. 175 and 179.

- "German firms, 150 miles from a shipping port, could reach Antwerp by railway for  $3\frac{1}{2}$  marks, or  $3/6$  per ton of finished iron or steel" - it was clear that substantial reductions had been made on the already low freight rates of the 1880's. Indeed, if the outstanding advantage of excellent railway facilities for the American iron and steel industry had been extremely cheap assemblage of raw materials, for Germany it seemed to British observers to be an excellent base from which to launch an assault on British export markets.

Belgium was the first country in the world to plan a coordinated national railway system; the base of the plan, conceived in 1834, was the construction of two trunk lines, one from Ostend eastward towards Germany, the other at right angles to it from Antwerp to the French border. Built for the State on borrowed capital, the Belgian railways followed the English pattern; if anything, even more attention was paid to the study of engineering, fuel and cost accountancy problems. Freight rates were low - too low at the commencement in that the railways incurred losses - and, as a result, as well as stimulating the growth of Antwerp, the iron industry received a great boost. Belgium's iron industry was based on its coal resources, notably in the Liege district, and most of the iron ore consumed was imported. Geographically, the Belgian works were more favourably located than their Rhenish-Westphalian competitors for sea-borne ore, especially the superior Spanish ores. According to Bell, in 1885 the carriage on imported ore per ton from Antwerp to the blast furnaces was  $2/4\frac{1}{2}$  by boat or  $3/6\frac{3}{4}$  by rail, which made the "Belgian smelters a little unfavourably situated than the works in South Wales, as the sea freight to Cardiff is less than to Antwerp and the carriage to the Welsh works from the port is also a little lower". In the same period, ores from Luxembourg to Liege or Charleroi cost 6/- to 7/- per ton for carriage. Ten years later, transport costs had been reduced by from 35 per cent to 45 per cent; the ton-mile rate was between 0.35d. and 0.45d.. Iron and steel goods for export through Antwerp, for example, cost an average

0.51d. per ton per mile.

Black Country Policy.

The meetings of the South Staffordshire Iron and Steel Institute in the 1880's and 1890's sometimes witnessed the occasional sign of animosity between the ironmasters of the district and the managerial ranks. Accusations were, in fact, levelled at the ironmasters that they had failed entirely to do anything concrete about the question of high freight rates. To be fair to the ironmasters it was not for want of trying; unfortunately, the question of railway rates, at least in the minds of many involved with the industry, had become acute. It was well known, for example, that Nettlefolds had moved their steelmaking division from Wellington, Salop, to South Wales because of differences of opinion with the railway companies; several other firms in one or other of the staple trades had already moved, or were actively considering a move, to a coastal site. Small concessions were, indeed, won from the railway companies; reference has already been made to Hickman's success and in 1885 the Freighters' Association had won a slight reduction on the freight rates on galvanized sheet to London and Bristol. When, however, the Standing Joint Committee on Railway Matters of the Black Country Chambers of Commerce, together with a number of local mayors, petitioned the railway companies for a general lowering of export rates, they met with failure.

The BITA Report on conditions in the German and Belgian industries was published in the year when the now Sir Alfred Hickman was the Association's President; also, on the delegation to visit the Continent was J.S. Jeans. Both men were, of course, prominent critics of the English railway companies and it should have come as no surprise that the report should contain some unfavourable reflections on the home railways in comparison with those of Germany and Belgium. Extremely low rates were quoted for the main routes in Germany and Belgium and the rates for two districts of similar location - Couillet in Belgium and South Staffordshire - were contrasted:

<u>Name</u>	<u>Distance</u> <u>Miles</u>	<u>4-10 tons</u>	<u>Rate per</u> <u>ton mile</u>	<u>10 tons</u> <u>upwards</u>	<u>Rate per</u> <u>ton mile</u>
Couillet- Antwerp	70			3/-	0.51d.
S. Staffs.- London	113	15/-	1.502d.	12/6	1.327d.
S. Staffs.- Liverpool	97½	10/-	1.230d.	10/-	1.230d.

In the discussion on the report held by members of the Institute it was, however, noticeable that voices were raised against making a straight-forward comparison between English and Continental rates. Jno. W. Hall, noted for a certain degree of obstinacy in the face of popular argument, gave a fair summary of the differences:

"We have also to remember that in Belgium, at any rate, railways can be made very much more cheaply than in our country; because that country is almost dead flat, whereas this country has to be tunnelled and embanked. Land there is obtained at less cost than here, and in several ways there are greater facilities for construction. They are also able to buy cheaper material, they have cheaper labour, they have a better-thought-out system of railways than we have, and, consequently, they have long straight runs, whereas our railways were originally made from Little Poddington to Little Puddington, stopping at both ends".(113)

Meanwhile, local ironmasters were seeking alternative means of cheap transport; indeed, it was the view of many in the district "that things would never improve whilst the district had no real alternative to the railways for transport of goods. As things were, the canals were not a 'viable alternative'". (114) E. Parkes had frequently argued for a greater use of improved canals, whilst F. Scarf, of the Bromford Iron Company, thought that "a canal capable of carrying barges of 150 tons capacity need not be expensive (to construct), and it would effect an enormous reduction in present rates". (115) There was considerable disagreement,

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(113) Proc. S. Staffs., xi, 1895-6, p.191.

(114) Colliery Guardian, 3/2/93.

(115) Proc. S. Staffs., xi, 1895-6, p. 91.

amongst Black Country ironmasters, as to which waterway should be improved - to London, Liverpool or Bristol. In fact, each route had its supporters. A most ambitious scheme, but one which received the least support, entailed the construction of a Birmingham-Liverpool Ship Canal; a survey was carried out by a number of people, including Sir James Brunless and Edwin Clark, and agreement was reached in principle for a canal, 72 feet in width, to run from Birmingham, through the Black Country, to Wolverhampton, "thence, in a line almost due north, to Stoke-on-Trent, through the heart of the Potteries, and then, in a north-westerly direction, to Kids Grove, Wheelock and Winsford, where the canal would meet the Weaver at a place called the Top Flashes". The canal, a total of 61 miles and costing an estimated £2½ to £3 million, would have been large enough to accommodate sea-going vessels of 300 tons burden, or barges of 400 tons. Nothing came of these plans. The second scheme was a proposal to improve the existing canal navigation between the Black Country and Bristol. E.D. Marten, engineer to the Severn Commissioners, was engaged by the Bristol Chamber of Commerce, following close discussions held with local bodies in Wolverhampton under the chairmanship of Sir Alfred Hickman, to draw up plans. Marten came up with a scheme to cost an estimated £360,000, and which would have ended the different gauges on the existing canals. Full use would have been made of the river Severn; some disappointment was occasioned by Marten's belief that it would have been far too costly to have altered the canal system from Wolverhampton to Aldersley Junction. (116) Annual running costs were estimated at £14,000, but if only one quarter of the existing traffic could have been diverted from London then, at a toll of 2/9 per ton, revenue would have amounted to £68,000 per year. Amongst the reasons for the failure of this scheme to come to fruition was the realisation that Bristol handled such a small percentage of Black Country trade, compared with both London and Liverpool.

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(116) Colliery Guardian, 3/2/93.



The third proposal was Hickman's contribution. Having outlined various ideas in a pamphlet entitled "Improved Means of Water Communication between the Midlands and the Ports of London, Liverpool and Gloucester", Hickman decided on a "proposed canal between Birmingham and London to carry steamers of 120 tons burden". Steam tugs could be used, each capable of drawing three barges, and Hickman also suggested the abolition of locks as far as was possible.(117) A Committee of the Wolverhampton Town Council was set up, under Hickman's chairmanship, to consider the proposal:

"The Committee estimated that the traffic between Wolverhampton and London was three times as great as between Wolverhampton and Liverpool, and seven times as great as between Wolverhampton and Bristol.

They concluded, therefore, that it was most important first to enlarge the waterway to London".(118)

Another factor which helped to convince Hickman and his committee that the route to London should be tried first was that the waterway to London from the Black Country was in the hands of independently-owned canal companies. The most important of these, the Grand Junction, was marginally paying its way, but only because it charged a high rate; this was mainly due to the fact that the smallness of the canal made imperative the use of small boats. Following the engagement of an engineer to draw up plans, the cost of the project was estimated at £1.25 million, whilst "the benefit to be derived therefrom was a reduction in carriage charges on iron from 12/6 per ton to 6/-; and on coal from 6/9 to 4/-". Much to Hickman's disappointment, when the scheme was put before the Councils of Birmingham and Wolverhampton - "in the hope that, conjointly, they would be willing to guarantee a low rate of interest on the capital required taking into account the enormous advantage the undertaking would be to the whole community" - there was no positive response. Some people felt

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(117) Colliery Guardian editorial agreed with Hickman's proposals.

(118) Memorandum presented by Sir Alfred Hickman to Wolverhampton Town Council, quoted in Proc. S. Staffs., xi, 1895-6, p. 116.

that with the Manchester Ship Canal nearing completion at that time, it would be better to wait and see how such schemes turned out. Hickman was himself convinced that the two schemes were totally different:

"Of course the Wolverhampton and London project is conceived on very different lines to the Manchester Ship Canal, and, personally, I have no doubt whatever that it could be a commercial success and at the same time confer enormous benefits upon South Staffordshire". (119)

Thwarted in such efforts to create what Parkes called "a cheap inlet and outlet for our goods" - there were plans to build a road from Coventry, via Birmingham and Wolverhampton, to Manchester and Liverpool under private enterprise but these, too, came to nought - the iron and steel industry continued to plug away at the railway companies in the hope of gaining reductions. Voices were occasionally raised in favour of the public ownership of the railways, but the idea did not gain widespread support. On one occasion it was pointed out that "any wholesale interference" with the railways in Britain "would cause a serious disturbance of the general interests of the community". Considerable praise had been given on that occasion to the German state-owned system, but a pro-British railways speaker warned: "The one system you see is carried on by a military high-handedness, the other is the free-handed dealing of commerce". (120)

Instead of seeking outright state control, responsible bodies in the Black Country began to demand more active participation in the running of the railways either by the Railway and Canal Transport Commission or by the Board of Trade. In 1893, a committee under the chairmanship of Shaw Lefevre, of which Sir Alfred Hickman, M.P., was a member, had considered the possibility of a system whereby the Board of Trade would decide between traders and the railway companies in matters of dispute, but had

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(119) Letter from Hickman to H.M. Punnett, quoted in Proc. S. Staffs., xi, 1895-6, p. 116.

(120) Ibid, p. 106.

then rejected the idea. H.W. Edmunds, Chairman of the Railway Rates Committee of the Birmingham Chamber of Commerce in 1911, raised the idea again when he advocated a "general extension of the powers of revision and direction and control by the Board of Trade" in the administration of the railways before the Departmental Committee on Railway Agreements and Amalgamations. (121) Edmunds argued that it was far too expensive (he quoted figures of £2000 - £3000) for any but the largest firms to take the railway companies before the Commissioners; the latter were, in fact, far too inaccessible. Edmunds went on to stress three complaints felt by the Black Country industrialists and traders to be fully justified: first, whilst the travelling public had received "enormous advantages in the way of cheap excursions", the trading community was "in no better position than it was 20 years ago"; secondly, there had been an increase, if an 'indirect one', in the rates on coal and coke; thirdly, there had been no inclination by the railway companies "to remove rate preferences given to foreign merchandise". (122) An interesting omission from Edmunds' list of complaints was his failure to mention railway monopoly. For years, the Black Country spokesmen had argued the evils of monopoly (W.A. Walber, representing the BITA before the 1911 Committee did, however, raise the matter of the "agreements" between the three companies serving the district) (123), but in 1909, Sir George Hingley, from Netherton, near Dudley, clearly voiced a change of emphasis:

"I am not at all sure that trading interests are injuriously affected by working agreements or amalgamations, and with proper safeguards, consider they are not much to be feared. The fact is that competition

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(121) Report of the Departmental Committee on Railway Agreements and Amalgamations, 1911, M.E. 5755.

(122) Ibid, M.E. 5819.

(123) Ibid, M.E. 3982.

has done practically all that can be expected from it, and if anything is to be obtained, the companies must be allowed to effect economies. There is no doubt, I think, that at present there is much duplicate service which might be avoided - and consequent waste...". (124)

Reference has already been made to Edmunds' third point; it was a serious issue which affected other inland manufacturing areas besides the Black Country. Perhaps the fullest case against this practice of the railway companies was given in 1911 by J.W. Sissons, representing the Sheffield Chamber of Commerce. Sissons was especially angry over the fact that the railway companies serving his area also had large interests in - if not outright ownership of - the steamships which sailed from the ports to which the railways carried the goods for export. Pressure was put on traders and manufacturers to use those ships 'suggested' by the railway companies, and through rates, i.e. Sheffield to Hamburg, were quoted to the manufacturers. Further information given by Sissons goes some way

List of Docks, Harbours, Piers, Wharves and Quays Owned, Leased, Worked or Controlled by the Great Western, London and North Western and Midland Railways (125)

<u>Docks, etc.</u>	<u>Railway Company</u>
Briton Ferry	Great Western
Brentford	" "
Burnham(Somerset)	" "
Chelsea Basin	London & North Western and Great Western
Fishguard	Great Western
Fowey	" "
Garston Docks	London & North Western
Heysham	Midland
Holyhead	London & North Western
Llanelly	Great Western
Plymouth	" "
Porthcawl	" "
Saltney (Chester)	" "

towards explaining why Black Country spokesmen did not make too much of this fact in 1911. It would appear that they had won some concessions from the railway companies. Sissons stated that Birmingham traders were

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(124) Report on Railways, 1909, M.E. 4043.

(125) Material extracted from 1911 Report.

given preferences over traders from Sheffield on a number of items with regard to sea freight; sea freight on iron and steel (railway classification C) was 7/6 ex-Sheffield, and 4/- ex-Birmingham, whilst on hardware it was 15/- and 10/- respectively:

"The through rate (to a European port) inclusive of the rail when ex-Sheffield is 49/1 and when ex-Birmingham, Wolverhampton and Stourbridge is 35/- .... I might say that there is a most deadly competition between such places as Sheffield, Birmingham, Wolverhampton in this trade. It is a hand to hand fight and this 5/- per ton is a very important item."

(126)

By the Edwardian years, it is clear that the Black Country ironmasters were no longer so concerned over the high freight rates. This was, no doubt, in part due to a general recovery in prices (except at times of severe economic dumping by either the Americans or Germans); also, of course, the finishing trades tended to benefit from the practice of the railway companies in allowing imported iron and steel goods into the country at what amounted to cheaper freight rates (inward sea freights were often 40 per cent lower than outward freights). Equally important, however, was the belief that South Staffordshire would stand to benefit from its close proximity to East Midlands ores; instead of the former aversion to Northamptonshire ore, there was now a proud boast by William Foster, President of the South Staffordshire Institute for the 1908-9 Session, that South Staffordshire, Northamptonshire and other Midland centres were "still producing the cheapest pig in the world". (127) There was a certain astonishment, if not euphoria, in the knowledge that Northants ore was being carried up to Middlesbrough - "That showed the fortunate

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(126) Report of the Departmental Committee ..., 1911, M.E. 8135-8141.

According to Sissons, too, Gannock had to pay a sea freight of 15/-, thus making it 5/- worse off per ton of exports than the neighbouring towns of Birmingham, Wolverhampton and Stourbridge.

(128) *Proc. S. Staffs.*, xxiv, 1908-9, p. 10.

(127) *Proc. S. Staffs.*, xxiv, 1908-9, p. 10.

(130) *Proc. S. Staffs.*, 1908-9, p. 100.

position which the Midlands occupied with regard to ore supply, when even Middlesbrough was coming to this district for a portion of its ore requirements". (128) Finally, local ironmasters had at last realised the excellent position which the Black Country held to receive "an ever-increasing quantity of iron and steel scrap of considerable variety". Foster commented in his Presidential Address: "This material deserves our best attention, owing to its capabilities in promoting to a great extent the future prosperity of the iron and steel and allied industries in the Midlands". (129)

High freight rates, in the period of increasing domestic and foreign competition, clearly played a significant role in the changed circumstances of the Black Country. Whilst it would be almost impossible to estimate the actual extent of damage caused either to the area as a whole or to individual firms by the inadequate transport service provided by the railways it was, nevertheless, of considerable importance. A conservative estimate put the railway charge in the early 1890's as equal to 10 per cent on the average selling price. Most significant, the haulage issue helped to create an air of despondency and dissatisfaction which cannot be measured in statistical terms. The 'scientific' approach of the econometrician would simply miss out on this point, just as it was no comfort for the local ironmaster to be informed that he had to pay higher rates than his Continental or American competitors "because land, Parliamentary expenses, rates and taxes, and other outgoings (took) a higher range in this country than abroad, however much these facts (controlled) the situation". (130) For the average Black Country ironmaster, who kept no proper accounts, it was more significant that he personally was convinced of the high freight rates to and from his district. As such, freight rates were one more link in the concatenation of circumstances bringing about the decline of the Black Country as a leading iron and steel producer.

(128) Proc. S. Staffs., xiv, 1908-9, p. 10.

(129) Ibid., p. 10.

(130) BITI Reports 1932, p. 100.

(2) Proc. S. Staffs., 1908-9, p. 10.

## Chapter 5 " Masters and Men."

Following the great deal of interest shown in the Belgian iron and steel industry in 1894 - the meeting of the Iron and Steel Institute had been held in Brussels - W. Jacks, M.P., and S. Jeans drew up a report on the question of Belgian and German competition which they then presented to the board of management of the BITA. One of their main themes in the report was that lower wages in both Germany and Belgium was the chief cause of their success in markets formerly the exclusive preserve of the United Kingdom industry. In the supply of raw materials, Jacks and Jeans suggested that United Kingdom wages were 65 per cent higher than in Belgium or Germany; less wages were paid by the Continental industries than in the United Kingdom at the blast furnace stage, although this was in part due to the fact that both the average output of German blast furnaces had increased greatly (100 per cent increase in the period 1881 to 1893) and the average output of pig iron per worker had jumped from 136 tons annually in 1881 to 206 tons in 1893.(1) With the publication of this report by the BITA in May 1895 there was a strong reaction by the men's leaders in the Midlands; a decision was made for them to visit the Continent and find out for themselves the true state of affairs. Hearing of this decision, the employers decided to send their own delegates and, a little surprisingly, a joint delegation of employers and men's representatives was agreed upon. The aim of the Delegation (organised now under the auspices of the BITA) was to investigate "the wages, paid, hours of work, conditions of workmen, etc.", and to conduct enquiries at particular works. Representing the Midlands were Major James Patchett, managing director of the Shropshire Iron Company of Wellington, W.H.D. Gladstone, of Messrs. John Lysaght of Wolverhampton, Bristol and London, W. Aucott, operative secretary of the Midland Wages Board and President of the Associated Iron and Steel Workers of Great Britain, and S. Harris, vice-chairman of the Midland Wages Board.(2)

(1) Colliery Guardian, 24/5/95.

(2) Proc. S. Staffs, 1895-6, pp. 73-74.

Briefly, the Delegation found that as far as fuel was concerned, "it appears that Belgium stands at a disadvantage as compared with this country". The average price of a ton of coal at the mine was put at 7/5<sup>1</sup>/<sub>4</sub>d. (it could be as high as 8/8), compared with between 6/1 and 6/6 in the United Kingdom. For Germany, the cost of coal "at the mine's mouth" was about the same as in the United Kingdom. Where both Continental countries scored over the United Kingdom was "with the system generally adopted in both countries for the recovery of the by-products of the coal in the process of manufacturing coke". With regard to iron ore supplies, both Germany and Belgium imported ore, but Germany less so than Belgium. In the case of Bessemer ores, imported from the north and south of Spain, "the German works can have no advantage over our own". What impressed the Delegation most with regard to the workmen employed at the various works visited "was the splendid discipline maintained"(3), and their "splendid physique"(4). Relations between management and workers <sup>was</sup> also excellent. The living conditions of German and Belgian workers were further admired, especially the provision of loans to the workers to buy their own houses, arrangements which tended "to bind the workmen more closely to the locality and hence to give more

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(3) "Each man worked as if he were a piece of machinery fitted into its proper place, which did exactly the right thing at the right moment, because it could not do otherwise. The operations, as a rule, were carried on with the regularity of clockwork". (BITA Report, Iron and Steel Industries of Belgium and Germany, published in Proc. S. Staffs., 1895-6, p.83.)

(4) "The Delegation was greatly struck with the splendid physique of the men employed in the works that were visited in Germany, and not less so with their sobriety, their steadiness, and their readiness to act on instructions". By contrast, it was said of nineteenth century Bilston that it was the home of more 'pubs' than anywhere else in Britain.



steady service".(5) On the matter of wages, the Delegation was hesitant - one South Staffordshire ironmaster accused them of being "extremely indefinite" - but in their conclusions the following points were made:

"Speaking generally of wages as a whole, they are undoubtedly lower in Belgium than either in England or Germany; but (as shown for the blast furnace department) there is a larger number of men employed there than here, and considerations such as those reported in the printed report of Works 'B' have also an important bearing on the question.(6) So far as Germany is concerned, the greatest difference with our country appears in the amounts received by many of the head "mill contractors", or rollers, whose counterparts practically do not exist in Germany, the engineer there taking full control, oversight, and responsibility of his department. Apart from these men, there is not the difference in the wages paid as between Germany and this country that is generally supposed to exist, taking into consideration the whole of the manufacturing departments in iron and steel works. In other words, the general distribution of wages is more evenly balanced, and we did not find the extremes that obtain amongst English workmen".

When the Report was presented to the South Staffordshire Institute, it occasioned a great deal of discussion and, in fact, provided a good

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(5) Whilst an M.P., Hickman, who signed the Report as President of the British Iron Trade Association, greatly interested himself in a scheme which, if it had been approved by parliament, would have enabled industrial workers to acquire their own houses. For Hickman's own workers, as elsewhere in the Black Country, there were a number of tied cottages. With regard to the seeming good behaviour of the German worker, this contrasted sharply with frequent attacks made on the workers of South Staffordshire. See views of men like Jno. W. Hall, Proc. S. Staffs. 1895-6.

(6) 24 men and 10 women were employed per shift at the two furnaces of 'B' Works. Work carried on through Sunday, with the iron going into 'the east house'.

opportunity for members of the local industry to look at their own performances. In turn, I have used the discussions on the Report to look at some of the factors relating to the personnel of the industry and to try to assess the general situation in the local iron and steel industry with regard to problems of management.

One of the major controversial aspects of the Report concerned the matter of the workers, both from the Continental industries and the local industry. Belgian workers came in for a certain amount of criticism, but not so "the brain power and discipline everywhere visible in Germany". The absence of strikes there gave the German producer a tremendous advantage over those in South Staffordshire and elsewhere in the United Kingdom. If wages were apparently a little lower in Germany there was the "paternal system" to be taken into consideration which gave the workers certain "compensatory advantages", as well as placing a heavy burden on the German producer. A brief investigation of the way the "State accident, sick and pension funds" worked showed that the three establishments looked at contributed £50,000, £40,000 and £35,000 per year respectively; in fact, the individual payments amounted "to nearly five per cent of the total capital of the concerns". The benefits amounted to about an extra 25 per cent on the wages of the workers, "so if we take these things into account we see that wages, although apparently lower, are really very much on a par with our own".(7) A number of works

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(7) Against this, it must be pointed out that other evidence, not included in the Report, suggested that the area visited by the Delegation was "the home of the aristocracy of labour in Germany". Wages, in fact, varied a great deal throughout the German iron and steel areas:

	£	s	d	
Rhenish Westphalian forge & rolling mills .....	50	2	0	(per year)
N-W Iron & Steel Industries ....	44	14	0	
N-E " " "	44	4	0	
S-W " " "	42	3	0	
Southern " "	41	17	0	
Saxony, Thuringia "	41	8	0	
Silesian " "	30	6	0	

(Report of the Consul-General, Sir Charles Oppenheimer, 1893, "Labour times and Labour wages in Germany").

managers and masters attending the meeting of the South Staffordshire Institute found this very difficult to accept and one went so far as to accuse the Delegation of having given way to the workers' delegates on the question of labour and wages - "the most important business of the men's <sup>D</sup>elegates would be to prevent anything appearing in this Report which would tend to bring down the wages of their constituents".

In discussions over labour and wages amongst the 'management' of the South Staffordshire district three themes occurred time and again, first with the Belgians and Germans in mind and then, later, very much with the Americans in mind. How ready were the men to accept new equipment? Was the best use being made of the available labour? What type of person was being recruited into the industry at the operative level? The puddler of the Black Country, indeed, occupied a very distinctive position. Brief reference has already been made to the fact that great physical strength was required in the stirring of the molten pig with the 'rabble' and 'puddle', but also considerable skill. Furthermore, it has been remarked upon that the puddler had earned a reputation for conservatism and opposition to new ideas. Speaking of the puddler in general, and not necessarily from South Staffordshire, Sir Lowthian Bell remarked that he was hidebound by traditional practices. He was capable, for example, of doing more work "than he usually turns out, but practice has established six heats or charges as the proper quantity, and as soon as he finishes this he goes home, leaving his furnace for an hour or more doing nothing, while the foreign furnace is kept at work almost uninterruptedly".(8) Furthermore, it was well recognised by Black Country managers that the puddler's opposition to progress had done much to bring about the failure of Danks' rotary puddling furnace.(9) In 1874, for example, a bitter dispute had taken place at the Round Oak Works,

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(8) Sir Lowthian Bell, The Iron Trade of the United Kingdom, 1886, p.88.

(9) Proc. S. Staffs., 1895-6, p. 96.

over the installation of a mechanical puddling furnace, and the men had only returned to work on the advice of their union leaders. Jeremiah Head, (10) in fact, believed that the puddler would oppose any new equipment for the puddling furnace - "the puddler was a contractor and would say "I will work at the district rate per ton of iron produced, provided you give me an appliance I am accustomed to work with, i.e. the ordinary puddling furnace".(11)

Head also had some discouraging things to say about the furnace builder. The latter would be given a "certain price per ton for maintaining the ordinary puddling furnace" and "if they had anything added for the purpose of economising fuel, they would be sure to find such additional apparatus was neglected and gradually fall out of use".(12) Head was sure that

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(10) In the 1870's, Head was himself a mill-owner, but later on he established himself as a consulting engineer. Burn remarks, a little pointedly, that Head showed much more enthusiasm for new machinery after he became a consultant.(D. Burn, op cit, p. 300.)

(11) The same situation was to be found in the South Wales tinsplate works. J.H. Jones stated that "until quite recently in this country the efficiency of labour in most of the departments varied little between different places, for the output of each mill was limited to 36 boxes per shift of eight hours" (The Tinsplate Industry, 1914, p. 132). R.A. Mott (op cit, p. 100) records exactly the same situation in the coke industry; for example, coking time of the first battery of by-product ovens at Crook was 72 hours, as in beehive practice.

(12) The differences between American and South Staffordshire practice with regard to paying maintenance operatives are interesting. In South Staffordshire they were paid for the actual work carried out on the furnace (with the result that long periods were spent on furnace repair), whereas the tendency in the United States was to reward the person for the least amount of work done in the way of repairs. The logic behind this was simple. It was the furnace which produced the iron and kept the majority of workers busy - both were idle when the furnace was undergoing repairs.

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"unless an altogether disproportionate amount of attention was paid by the principals or their managers, any novel arrangements fell into dis-use". Several years later, he raised the same mis-givings with regard to the introduction of the Wellman Charging Machine into Britain (then widely used in the United States) - "they had another factor which ... would probably interfere with the adoption of this machine in number to their furnaces, and this was the consent of the men. They had not in the past got the returns from the men they should have for the capital laid down for labour-saving".(13) Head's comments are obviously hostile to labour, as well as illustrating the very limited approach to the wages and productivity issue that existed generally throughout the British industry at that time. If new equipment was installed to increase production then the worker was surely entitled to think that a new wages agreement was necessary. Despite the many adverse comments which were expressed about the American industry in this period, this is in fact the line taken by the majority of United States manufacturers. H. Pilkington, speaking on one occasion to the South Staffordshire Institute, was perfectly justified in wondering whether or not British employers had played fair with their men, as American management had dealt "fairly and squarely by their men".(14) In England, the employer very often wanted to take all the advantages which could arise from the introduction of a new piece of machinery and leave his workers worse off than before:

" ... in America ... when a piecework price is fixed ... and the man increases the production and makes big earnings for himself, the American employer gives it him without grumbling, whereas in this country the employer would probably dock the rate. In America, so long as that particular job of piecework is in force the rate holds good. When any man introduces any idea, also, by which he makes a bigger amount on a piecework job for himself, then he gets the full

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(13) J.I.S.I., 1897, i, p. 109.

(14) Proc. S. Staffs., 1901/2, p. 103.

benefit of that kink or new idea which he introduces. The employer does not, as he does in this country, penalise the results of the ingenuity of the workman".

The same unawareness of the worker's point of view, as witnessed by Head's comments, perhaps even an insensitivity, can be seen in a comment made by Ebenezer Parkes. He recounted the story of an Englishman visiting an American works and being much impressed with a labour-saving machine; the process in England took twenty-four men to perform, whereas in America it was taking only two. Parkes continued:

"The Englishman called his men together and asked them how many men they could dispense with if they had the American machine. They consulted together and came and told him that they thought they might manage with two less. So you see that meant twenty-two men in England against two in America for the same work".(15)

Here is an example of the worst type of labour relations - Parkes was either naturally unaware, or chose to be so, of the reluctance of the working man to accept possible redundancy in face of increased automation.

It was almost inevitable that the more advanced trade union development in Britain should receive its share of the blame in reducing the worker's willingness to accept change and new machinery. Commenting on the BITA report, H.M. Punnett, of Punnett, Thompson, and Company, Sheet Iron Manufacturers of Birmingham, stated:

"The great lesson which Labour and Capital has to learn from the Report is that the Continental races by industry, regularity, discipline and thrift, are doing as good work as we, at our best, with greater happiness and at less cost".

He found much evidence to support his view that the German worker welcomed new machinery "and the introduction of new ideas". Punnett had much to say in favour of English labour, but he found the "deadening influence"

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(15) Proc. S. Staffs., 1901-2, p. 90.

of certain trades unionists to be harmful:(16)

"Even here, we are in great danger of suffering from the deadening influence of that form of trades unionism which maintains that a rule once made cannot be altered, whether it applies to the heats of a puddler at work, whatever his furnace may be capable of, or to the schedule of the sheet mill wages, which is spoken of as almost inspired, although those who framed it know only too well that it was simply a compromise between the highest and lowest wages paid in the different works at the time it was drawn up".

Ebenezer Parkes, in his customary one-sided, and often exaggerated, manner, frequently complained of what he called "the restrictive practices of trade unions". He had come away from his visit to America (BITU Delegation to the United States in 1901) totally convinced of the superiority of United States techniques; equally, he had no doubt as to which group was to blame for much of this state of affairs:

"The American workman knows little or nothing of them (restrictive practices). Each man is encouraged to do as much as he can, and he is paid by results. ... I was told by Americans that the great cause why they were so much ahead of us was that the men controlled the situation in England, whereas in America there was nothing of the kind, and both workers and men strove together to see how much they could produce for a day's wage".(17)

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(16) Proc. S. Staffs., 1895-6, p. 115.

(17) Recent research in America on the Labour question tends to confirm the view that English visitors like Parkes had accepted a very narrow view of the trans-Atlantic situation. Almost certainly, Parkes would not have spoken with the leaders of American labour and so obtained the other side of the story. The American worker was caught up in what I. Yellowitz (amongst others) has termed the "success ethic" (The Position of the Worker in American Society, 1865 - 96, 1969). He "was exposed to a success ethic which tried to win his allegiance for the capitalist

Undoubtedly, increasing competition from the Continental industries had compelled the local South Staffordshire industry to look critically at itself. If the South Staffordshire 'management', as was the case elsewhere in the country, was only too ready to blame labour for many of the ills which had to be contended with, there was an inevitable reluctance to admit that Black Country managers might be falling behind their Continental and, a little later, American opposites. Sir Lowthian Bell summed up one aspect of what was really a widely held view on the issue of the uses made of labour:

"The power of producing cheaply depends on the cost and efficiency of human labour ... with the exception of the royalties and profit on railway carriage, the expense of manufacture consists almost entirely in wages paid to workmen".(18)

Because American labour was so dear it would follow, if Bell's inter-

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system by promising him a share of its fruits" (p. 1). It "encouraged innovation and progress, and it was the best method of distributing wealth"(p. 22). Collective action within labour organisations, rather than "isolated efforts of individuals", was anathema to the "success ethic", and American employers did their utmost to ensure that the former did not come about. Yellowitz writes: "Most first generation immigrants continued to work at unskilled or semi-skilled work, and they felt the impact of the newcomer most strongly. This led steel companies, for example, to employ a multi-lingual work force composed primarily of newcomers and first generation immigrants. It was hoped that the tensions amongst the workers would block the growth of unionism and keep labour costs at a minimum" (p. 11). Jeremiah Head admired the way American managers (his son was a director of the Otis Steel Company) mixed the different races, thereby hampering "cohesion and united action" and making "the methods of the 'New Unionism' difficult to enforce" ( Proc. S. Staffs., 1897-8, p. 120).

(18) Sir Lowthian Bell, op cit, p. 81.



pretation had been correct, that American production costs would be very high. Bell, in fact, frequently stated that this was so, failing to realise, unlike Thomas Ashton of South Staffordshire, for example, who stated that "more labour was exacted in a given time from the American than an English workman" because of the "more improvements in machinery now so general in America".(19) Indeed, some English manufacturers came to believe that men working in America produced 50 per cent more work than they did in England - with the same tools. Parkes found it worth mentioning that "every man there seems to have an ambition to get on and to succeed in life and build himself a house, and have that house as comfortable as he possibly can". Le Neve Foster, too, came to realise that there was nothing to be gained, either for the employer or the workman, from cheap labour:

"... as our workmen get better educated, we shall find they will not be content to do the work that can be done better and more efficiently by machinery; that it is to their ultimate advantage to employ labour-saving appliances, and that the appliances instead of decreasing the value of labour really increases it, as they not only obtain higher wages but are able to buy cheaper, and so obtain a greater value for those wages".(20)

Parkes again and again repeated before the South Staffordshire Institute that the old argument no longer held good regarding Britain's lower wages making it unnecessary to find and use labour-saving appliances. The local industry had much to learn from American practice with regard to blast furnaces and mills; not only did American methods create more efficient means of production but they also resulted in better working conditions:

"... in every shop, great or small, where weighty goods have to be moved, there are in America over-head electric travelling cranes. In

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(19) Proc. S. Staffs., 1897-8, p. 125.

(20) *Ibid*, p. 37. See also H.H. Campbell, *op cit*, p. 430.

one shop alone I saw seven 75-ton electric travellers. Large pieces of machinery, railway cars, locomotives, and immense castings of all kinds, are moved about as though they were toys".

In the Institute's discussions on the BITA report, Punnett raised another aspect of the same problem. He observed that fewer men were used in sheet mills in Belgium than in this country and, because of the introduction of a "rack arrangement"(21) the work was less arduous than in most South Staffordshire mills. German sheet mill practice had struck a number of local managers as being too dangerous (the high speed "at which the rolls were running, say upwards of 120 revolutions per minute, or three times as fast as is usual in this district") but, again, Punnett could see no reason why the foreign practice could not be followed in South Staffordshire. It was more a question of the use made of labour in running "machinery of a high order for rolling either iron or steel plates". There was very little danger - "the screws are not touched by the roller or his breaker down, but are regulated by a boy controlling a central wheel, moving both screws at the same time" - and greater output at less cost. Punnett did not think that it was too late for South Staffordshire to alter the conditions of labour "to a great extent", and the "first thing to consider with regard to any such change is whether we can adopt the German method of more men, more equitable distribution of wages, and, if possible, get more contentment and steadiness of work as the outcome".(22)

J.J. Chambers, having first read the report, commented on the sorry state of the manager's control over the puddler "in his neighbourhood":

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(21) This was a practice usual in the mills in Germany, as well as in Belgium, whereby the last end of the pack as it left the rolls was lifted by a lever under the control of a catcher or a boy.

(22) Proc. S. Staffs., 1895-6, p. 94.

(23) ibid., p. 125.

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"Whether the works is going to pay or not depends a great deal upon the working men. For instance, in a great many cases, puddlers leave three-quarters of their work to the underhand while they go drinking, and it is the same at the mill furnaces. Directly they have charged their heat away they go, and the assistant has to see to the firing - one of the most important things - himself. Consequently, a mill can soon be kept standing a quarter of an hour or twenty minutes because the firing has not been attended to properly, whereas, I suppose we may take it for granted - although the Report does not actually say so - that the Germans do not leave the works from the time they come in, until they leave for the day".(23)

Chambers had put his finger on a very important factor. Because of the widespread system of contract labour which still operated in the iron trade of the district, the management of a particular firm had no direct control over large parts of the labour force. In other words, although some iron and steel establishments in the area were large employers of men, the management either lacked the skill or were prevented, through local practices, from applying the principles of labour-management. Compared with the situation developing in the United States and Germany, the difficulties facing the South Staffordshire manager in obtaining the willing cooperation of labour with regard to such issues as the installation of new machinery were enormous. A feature of most of the local works (as was the case with many other British industries), indeed, was the list of rules "for the guidance of the Several Persons employed". In the absence of labour-management techniques, this was an attempt to maintain labour discipline through fines and various other punishments. The puddler, again, was singled out for a great deal of attention; in the case of "The Right Honourable William Baron Ward's Round Oak Works", he had received fourteen separate paragraphs from Richard Smith, the 'Principal

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(23) Ibid, p. 123.

Agent for the Proprietor". Failure to comply with the rules had meant instant dismissal or fines ranging from one to ten shillings for each offence. Engineers had been fined as much as one pound for such offences as neglecting the machinery under their control. Fines of one pound had also been imposed on people leaving the works without the manager's consent.

J.S. Jeans, in his capacity as secretary of the BITA, levelled criticism at certain South Staffordshire practices. He found it difficult to understand why the head rollers in some mills were so highly paid. When he had asked employers why this was so he had always been told "that the rollers were a special body of men, strongly organised, and that if they were to go on strike, it would probably be difficult to replace them - the more so that they take great care to limit their possible numbers".(24) Jeans argued that this could not have been the case in the United States, otherwise the mass development in the sheet, wire and other branches of the industry there could not have taken place. The President of the American Steel Trust had, in fact, informed him that "he could take a fairly intelligent agricultural labourer, fresh from the plough, and make a roller of him in a few months". Jeans concluded:

"If this can be done there, it can surely be done here as well, and if it can be done here, the extraordinary high wages paid to these men surely calls for further explanation".

The BITA report occasioned further discussion on the question of scientific and technical education. For the iron and steel industry this was in no way a new topic, although now it was seen very much in the light of growing Continental and United States competition. Those representatives of the local industry who had given evidence to the 1867-8 Select Committee on Scientific Instruction had not been impressive.

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(24) Proc. S. Staffs., 1901-2, p. 95.

Having sifted through the evidence, D. Burn suggests that the "industrialists of the Midlands" did not appreciate many of the issues to do with education on the grounds that "generally (they) had no technical training themselves".(25) He further suggests that they saw no reason either to give their own sons "a long or a scientific education", or that a workman with a basic education would be better able to hold down a foreman's post. There were, of course, exceptions to this even in the 1860's; Charles Cochrane(26) showed that he understood something of the difficulties involved when he told the Select Committee that 'good foremen' could be capable of the grossest mistakes in their work because of their total lack of "primary education".(27) It is difficult to see where the Black Country ironmasters of the 1850's and 1860's could have obtained their scientific education; many of them had served an "apprenticeship" with the leading ironmasters of John Wilkinson's day. A most unimportant ironmaster and colliery owner, G.R. Hickman, also found it worthwhile to send his son Alfred, born in 1830, to King Edward's Grammar School, Birmingham. What he was taught there, and what basic essentials of business he was able to acquire from his father, enabled him at 17 to set up as an iron merchant.(28) Besides, before the 1870 Education Act, and before many of the ironmasters disappeared in the harsher economic climate, a number of schools in the Black Country belonged to ironworks. Cynically, it could be argued that this type of factory school had been used by the ironmasters to ensure a steady supply of cheap

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(25) D. Burn, op cit, p. 12.

(26) Burn reluctantly admits (in brackets) that Cochrane, whilst being a "progressive Middlesbrough ironmaster", "also owned a works in Staffordshire". Cochrane liked to describe himself as an "ironmaster of Dudley"; see "Blast Furnace Practice at Ormesby Iron Works..", 1860-83, p. 163.

(27) S.C. on Scientific Instruction, 1867-8, M.E. 7210 - 22.

(28) G.R. Norton & M. Le Guillou, loc cit, p.1.

child labour, but at least the Old Park School at Wednesbury which belonged to Lloyds, Foster and Company provided some education for the working class. In 1865, for example, a 'new teacher' was paid the princely sum of "£60 per year and half the government grant of about £50".(29) Despite a "Lock-out and Colliers Strike", discipline was described as "very good" and "Intuition Satisfactory".

Throughout the 1870's and 1880's, the debate on the provision of scientific and technical education continued at national level. Increasingly, Germany, Belgium and the United States came in for praise, if a little grudgingly at times. Bell, in his Presidential Address to the Iron and Steel Institute in 1873, found that the Belgians had a very good system of technical education as far as iron and steel was concerned, and that they had given much more attention to the subject than had been the case in this country. In the face of criticism, no matter how mild, a number of influential people in the industry insisted that the British workman was the best in the world and that the British metallurgists were the equals of their foreign rivals. Dr. Percy, indeed one of Britain's few outstanding metallurgists of the period, took this as one of his chief themes in his Presidential Address to the Iron and Steel Institute in 1885. Speaking of the British worker, he said:

"These men are technically educated, having acquired that education in the only school where it can be acquired, i.e. where metallurgical processes, on the large scale, are conducted. Where else ... can the eye and the hand be educated? and without such education of what use ... would be a brain crammed with theoretical principles?"(30)

In any case, argued Percy, better educated artisans would simply demand more money.(31)

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(29) Minute Books of Lloyds, Foster and Company, entry for 1865,

(30) J.I.S.I., 1885.

(31) A very good account of technical education at the national level is to be found in P.W. Musgrave, Technical Change - the Labour Force and Education .... 1967.

Although the whole subject of technical education became a much discussed topic in South Staffordshire, it was not surprising that the district's spokesmen should be chiefly interested in the provision of metallurgical instruction. First among them was Thomas Turner, who was Director of Technical Instruction to the County of Staffordshire before becoming a professor at the new university college in Birmingham. Using the platform of the South Staffordshire Institute of Iron and Steel Works' Managers, Turner greatly influenced the provision of technical education in the Black Country. Speaking in 1895, he made a detailed attack on the failure at national level to provide for metallurgical instruction.<sup>(32)</sup> As late as 1895, none of the university colleges in the country had a metallurgical department; in fact, no such college could boast of "even a thoroughly-equipped metallurgical laboratory", let alone "a properly endowed metallurgical chair". Turner stressed the point:

"If metallurgy as a whole is thus neglected, iron and steel manufacture, or other branches of the subject, are naturally in even a worse condition, and in the United Kingdom we have no iron metallurgists to correspond with the veteran Von Tunner, of Leoben, or Ledebur, of Freiburg".

A number of the existing university colleges had given some attention to the teaching of metallurgy, but only as a very minor branch of chemistry. The Durham College of Science, for example, had appointed "a junior demonstrator of chemistry" to teach the metallurgical students. The person appointed had received no "special metallurgical training", but the subject had flourished sufficiently to warrant the appointment of a full lecturer in metallurgy. In another college, a so-called diploma in metallurgy had been "found to include more than three times as many lectures in natural history and physiography as in metallurgy, the practice of which was to form the life work of the student".

Turner was of the opinion that "until metallurgy teaching (was) placed

~~and the 1895-6 did not form a part of the curriculum~~

(32) Proc. S. Staffs., 1895-6, p. 26.

on the basis as, say, that of chemistry or physics, with an independent professor, having a seat upon the Board of Studies, with properly-equipped laboratories, and with efficient apparatus, comparatively little progress can be anticipated in the university colleges".(33) Turner's views were echoed by another member of the local iron trade, H. Silvester. In his Presidential Address to the South Staffordshire Institute in 1899, Silvester said that "whilst agriculture was dignified with a Chair at various colleges, metallurgy generally remained a mere adjunct to chemistry, and too often from lack of funds, lack of interest, or a combination of both causes, maintained only a sickly, maimed existence". Quite correctly, Silvester singled out the Royal School of Mines (34), King's College(35) and the Sheffield Technical School(36) as the

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(33) Proc. S. Staffs., 1895-6, pp. 26-27. Turner further stated: "From a metallurgical standpoint ... the university colleges of the United Kingdom during the last fifteen years, have been weighed in the balance and found wanting. The number of pupils attending the classes have been in many cases miserably small, while a considerable number have obtained on the continent the education which they were denied in their locality. The amount of research conducted in metallurgy, too, has been conspicuous by its absence. After all, the true criterion of the success of the teacher and of the utility of the subject, is the amount of useful research which is being done, and by this standard perhaps almost more than any other, the metallurgical training of this country has been altogether unsatisfactory".

(34) Founded in 1851 as the Government School of Mines and of Science applied to the Arts, London. The School of Mines was set up in answer to growing demands for scientific instruction, especially in the mining districts of Britain many of which, indeed, were centres of iron manufacture as well. Generally, the numbers of students were small and not until the 1870's did any former students achieve managerial status. Sir Lowthian Bell and Armstrong both knew of no one in the north of



three most important centres of full time metallurgical teaching. Turner was himself highly critical of the fact that two of the three leading centres of instruction at a higher level were situated in London, which

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England employed in the iron industry who had attended the School of Mines. A number of former students did gain important teaching posts, however, including Turner at Birmingham and A.H. Sexton at the Glasgow and West of Scotland Technical College. Dr. Percy and Professor Roberts-Austen were two of the more important teachers at the School of Mines. Turner, despite his obvious sense of loyalty as "an old School of Mines man", criticised it for out-of-date laboratories and equipment and for failing to give enough attention to the needs of the iron and steel industry. J.O. Arnold, of the Sheffield Technical School, in turn strongly criticised the School of Mines on the grounds that it taught "the metallurgy of the cram books and not of the steelworks".

(35) King's College, London. The second of the two leading metallurgical schools in London. Indeed, it was the only university college with anything approaching a Chair of Metallurgy. Sir William Siemens was chiefly responsible for the success of King's College in this field; he left the institution large sums of money, as well as providing apparatus and an annual gold medal and prize in metallurgy.

(36) Sheffield Technical School, regarded by many contemporaries as the leading centre for the study of metallurgy. According to J.W. Dixon, President of the Sheffield Chamber of Commerce, the original idea for a technical school came about because of the German lead in technical education. It was started and maintained by a number of leading men in the district and, after five years, was handed over to the town. Together with the School of Medicine and Firth College (founded by Mark Firth with a donation of £20,000), the Technical School came to form the university college of Sheffield. Much of the School's success was due to J.O. Arnold, who put his faith in the teaching of applied science, "scorning the pure scientist who held the view that knowledge applied for the benefit of humanity becomes knowledge degraded".

was "far removed from the chief centre of the metallurgical industry". He believed that local industrialists in the Black Country should be prepared to contribute towards a centre of metallurgical instruction similar to that in Sheffield. Indeed, largely due to Turner's persevering enthusiasm a metallurgy department was set up in the Mason College, Birmingham's university college. As a professor of that college, he continued to campaign for closer links between educational establishments and local industry, and it is no surprise to find that it was at Birmingham that the Faculty of Commerce made the first systematic attempt in Britain to prepare men for the higher positions of commerce as a university study. The Faculty was helped in their deliberations by an advisory board made up of businessmen.(37)

A number of people in the Black Country, greatly influenced by Turner, McWilliam (a lecturer in metallurgy to the Staffordshire County Council) and McMillan (another lecturer), were becoming aware of the deeper complications in the provision of technical education for the iron and steel industry. To some extent, they were the local counterparts of leading national figures like Sir Bernhard Samuelson, Chairman of the 1884 Royal Commission on Technical Education, Sir Henry Roscoe and Sir Philip Magnus. One problem was the suitability of instruction for, on the one hand, the numerous different industries, and, on the other, for the different levels of worker and manager. Turner was dubious as to the validity of the saying "Educate your masters and exact obedience from your men". It was a view held by Tyrer, President of the Society

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(37) P. Musgrave, *op cit*, p. 78. It would appear that Turner fared better with the Black Country industrialists than Sexton did in Glasgow. Speaking to the West of Scotland Iron and Steel Institute in 1896 on the subject of his Technical College he said: "When I look back on the record of this institute I can only wonder at the extreme apathy of the manufacturers of the district, especially the ironmasters, with reference to it".

of Chemical Industry in 1895, and, whilst conceding that it may have been "the main reason of German success in chemical manufactures", Turner correctly observed that the iron and steel industry was in a different category: "It can scarcely be classed as a purely chemical industry, nor, on the other hand, is it merely a mechanical trade in which manual dexterity alone is required".(38)

Obviously, Turner was well aware of the need to distinguish between the types of educational requirements, i.e. between the needs at operative level and "for the masters and others who have to lead". Twenty or so years after the coming into being of the 1870 Education Act, the training of operatives in the United Kingdom could now be based upon a system of state-provided elementary education. Prior to the mid-1870's, it had been almost impossible to give operatives systematic training which involved or required an ability to read and write. P.W. Musgrave, for example, correctly contends that the German worker, like his English counterpart, was trained in the job; "but the essential difference was that the training could be based on the compulsory education of the Volksschule".(39) Even an ambitious worker, because his basic education had been too weak, was virtually unable to take advantage of any later technical education which might be made available in the United Kingdom. Obviously, too, things had improved and it is very interesting to hear Turner advocating the extension of the school leaving age to fourteen so that "the men" could receive a "suitable education":

"... if the parents can spare the boy for another year, so much the better, though it is not advisable that a boy who is afterwards to become a workman should remain too long at school".(40)

Regarding the subjects to be taught, he stressed the need for the three 'R.'s; in the last two years at school more technical subjects would

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(38) Proc. S. Staffs., 1895-6, p. 21.

(39) P.W. Musgrave, *op cit*, p. 42.

(40) Proc. S. Staffs., 1895-6, p. 22.

be useful - "elementary chemistry and physics, machine drawing and construction, and instruction in the use of tools". Whilst the teaching of woodwork was thought important, "an early acquaintance with metals and familiarity with metal-making is more suitable to the needs of the youth in many of our industrial centres".

Turner raised several aspects of the provision of education suitable at a higher level. Over the course of a decade or so, his enthusiasm for part-time study at evening classes tended to wane; it was terminated following a visit to the United States. For the higher levels of technical education, he found that the Americans had no interest in evening tuition. They had a system of full-time education lasting three or four years, which was accepted "by manufacturers as the best training for the direction of the most important industrial undertakings". This was a point of view strongly shared by Professor Sexton in a letter addressed to the South Staffordshire Institute. Sexton believed that the industry's first need was for well-equipped central colleges, which would provide the type of education suitable for the future masters and managers. In fact, Sexton believed that it was in this sphere that the British industry fell farthest behind both the Americans and Germans. Another factor which greatly concerned Turner and others was the attitude of industry to college training, both as regards the amount of financial support it was prepared to make and to the provision of employment for suitable "graduates" of the university colleges. It was common knowledge in the 1890's that there were no United Kingdom equivalents of Andrew Carnegie or Rockefeller (£1 million to the University of Chicago), but what Turner was really interested in was the recognition by industry of the need to contribute towards the provision of technical education at university college level. He was aware that the average ironmaster was still indifferent to the type of place where his son should receive a satisfactory education; the average educationist, on the other hand, "would prefer

that the systematic course of instruction, commencing not earlier than in the student's sixteenth year, extending over three years, and requiring the whole of the student's time during that period, should as far as possible, be conducted in connection with a university college, and should be certified to with the stamp of a university degree".

University college fees were high, £30 as compared with 30/- per annum in Germany, and, whilst increased State aid to colleges was necessary, Turner was of the opinion that industry should make its contribution. If the provision of higher technical education was to be complete in Britain, then industry would have to follow the American pattern and find suitable jobs for the products of the university colleges. When on a fact-finding tour of universities and technical colleges in both the United States and Canada, Turner and Professor Redmayne had found remarkable the number of managers of works who had been to college or university. The same situation was found in Germany, whereas "in our district the managers who occupy important positions are almost to be counted on two hands who are able to say they have gone through a thoroughly good high-class institution, and have spent there three or four years". Turner spoke kindly of "the good old practical men" of South Staffordshire who had "risen from the ranks", but who lacked "the advantages of scientific training".(41)

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(41) Turner's comments are particularly interesting in light of Charlotte Erickson's researches on the 'men' of the steel-making era. She looked at some 60 men in all (Thomas Walker of Patent Shaft being the one she had selected from South Staffordshire). Only six men had academic technical training, although a good number under various guises had visited the Continent and/or the United States (C. Erickson, British Industrialists, Steel and Hosiery, 1850-1950, 1959, p. 165 et seq). James Riley, who at the age of 38 became general manager of the newly organised Steel Company of Scotland, "was exceptional in being the only manual worker to gain a position of leadership in the steel industry".

Locally, the South Staffordshire district made some headway towards the provision of technical education and not least in the important industrial town of Wolverhampton. Following hard on the meeting of the Council of the Wolverhampton Chamber of Commerce which drew up the reply to the questions asked by the Royal Commission on the Depression of Trade, came a Special Meeting of the Chamber and "district manufacturers" to discuss the matter of foreign industrial progress.(42) J.C. Tildesley, who chaired this meeting, listed technical education amongst a number of reasons for Germany's rapid progress in recent years in the iron and steel industries. He was supported in his view by the majority of speakers, including Mander, who expressed his anxiety to see "the town's School of Art get going". Mander, as well as wishing to see a school set up, wanted to see the creation of a museum "where samples of foreign manufacture might be exhibited." At a later meeting of the Council(43), a resolution was taken to support "Mr. Mander's suggestion to help the School of Art, Art Gallery and Free Library ... in view of the great competition from abroad in superiority of form and ornamentation as well as price in articles of every-day use largely manufactured in this district". Over the next few years, the question of technical education repeatedly occupied the Council's attention. Approval was given "to Mr. Howard Vincent's idea of Imperial Schools of Commerce(44), and a resolution supporting the government's bill regarding technical education (the Technical Instruction Act of 1889) was accompanied with the view that the "official cooperation of the Chambers of Commerce was needed in the direction and management of the schools proposed by the Bill".(45)

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(42) Entry in Minutes Books for 5 February 1886.

(43) Entry for 30 July 1886.

(44) Entry for 18 March 1887.

(45) At the same meeting a resolution was passed in favour of "the Oxford and Cambridge School Examinations Board's" proposed examination for a certificate of proficiency preparatory to a commercial career. The Chamber failed, however, to interest the local grammar school in the idea.

The Council also received the offer of financial help from the town's Liberal member of parliament, Sir William Plowden, who promised a sum of £100 towards "any fund aimed at providing technical education".(46)

The Council considered Plowden's offer and thought that it would best serve in going towards "the establishment of a chemical and metallurgical laboratory in connection with the Free Library Classes". The cost of such a laboratory was estimated at £500, £250 of which would come from the Science and Art Department at South Kensington. In actual fact, in 1893 Sir Alfred Hickman, recently victorious for the Tories in a general election, donated a further £500 towards the same laboratory.

In 1889, the Technical Instruction Act was, indeed, passed giving local authorities (municipalities) the power to levy a rate for that purpose; the next year the Local Taxation Act helped the movement towards the provision of technical education by providing County Councils with considerable funds to devote to this purpose. The local area took advantage of the new legislation. Wolverhampton, Walsall and West Bromwich all established centres where practical metallurgy could be taught; Staffordshire County Council set up a further seven centres in the southern half of the county where lectures were given by full-time staff. A number of scholarships, valued from £2 to £5 were also offered by the County "in order to defray the travelling and other expenses of promising students". By the mid-1890's, too, a laboratory for practical work had been established at Wednesbury<sup>5</sup>. The New Technical School, Birmingham, provided the best tuition in the area. In view of some of Turner's comments previously mentioned, possibly the area as a whole could be criticised for spreading its already slender resources over too wide a field. There was no shortage of places of instruction at the manual worker level; indeed, Turner was of the opinion that "in respect to

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(46) Entry for 21 October 1887.

classes for manual instruction in all probability Staffordshire stands well to the front, both in the number of teachers and the number of students". It was argued by some informed men that authorities like Staffordshire County Council had provided too many classes and that they had neglected both staffing and equipment:

"The small schools are necessarily poorly equipped, the teaching staff must be small, the work cannot be divided out, the teachers must be ill-paid, and the schools must necessarily be inefficient".

(47)

There is clearly some truth in Turner's view that the County would have been better advised to have set up a central college, or to have paid the fares of more students wishing to attend the university college in Birmingham.

Indeed, a powerful body in favour of technical education in South Staffordshire was the local Institute of Iron and Steel Works' Managers. First and foremost, the Institute provided a platform for members of the local iron and steel trade to discuss the problem. Professor Sexton, for one, was lavish in his praise of the Institute's work in this field, especially the rapidity with which they dealt with the problem in the light of the findings of the BITA Report on the German and Belgian industries. Numerous members of the Institute went on record with their encouragement to young members in their works to attend evening classes. Le Neve Foster, for example, urged "foremen, managers and others connected with workers to do this", whilst W. Somers, the Institute's President in 1901-2, commented:

"The great value of this instruction is its importance enabling the country to hold its own in its race of competition with other countries .... This technical education came none too soon; and it is

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(47) Proc. S. Staffs., 1895-6, p. 32.



for our Institution, composed of men who come in daily contact with so many of our artisans, to instil in their minds and make them realise the great advantage and value of technical education".(48)

Inevitably, there were members of the Institute who advised caution; Jno. W. Hall who, admittedly, was becoming a little testy in many of his views, warned the audience which had listened to Turner on the subject of technical education that "technical education was "not a patent pill which is warranted to cure all the diseases of the iron trade".(49)

In their criticisms of the type of recruit at the operative level, especially with regard to the question of technical education, South Staffordshire spokesmen became increasingly aware of the shortcomings of the personnel of the local iron and steel industry at managerial levels.(50) The BITA report clearly recognised the importance of an "ability to direct and control". In Germany, men who rose from the ranks of industry "had the additional advantage of a special scientific and technical education", a point which markedly made for a "more efficient and economic management - an important factor in Continental production". Contemporaries such as Turner and more recently, writers like Charlotte Erickson, have all testified to the absence in the South Staffordshire area of men with any formal high-level technical education. Indeed, a criticism which could be levied at the local industry was that too many sons followed their fathers in the same positions. C. Kirchhoff, the contemporary American commentator on the iron and steel industries located both sides of the Atlantic, believed that this tendency had brought about "the most striking feature of the attitude of the English

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(48) Proc. S. Staffs., 1901-2, p. 4.

(49) Proc. S. Staffs., 1895-6, p. 43.

(50) References on this in both P.W. Musgrave and C. Erickson with regard to South Staffordshire are scarce.

(51) C. Erickson.

iron industry today(1900) ... its pessimism and its lack of courage".(51)

Another American writer obviously shared this view when he wrote:

"In England there is a tendency for the management of an enterprise to descend from father to son, and an opposition to change, a magnifying of every tradition into a law of nature, and a disinclination to be different from others".(52)

There were still a number of what W.G. McMillan described as "masters of the old class" in existence in South Staffordshire in the 1890's; such a person had what he "considered an especial secret in his particular trade which gave him the advantage over his competitors; and, to put the whole thing into a nut-shell, he seemed to consider that the success of his secret was the secret of his success. It is scarcely an exaggeration to say that in some cases they were not aware (just because they isolated themselves), that nearly all their rivals had the same secret, and that it was to be found in the text books".(53) Obviously, keeping top management positions in the hands of the immediate family did not always result in weak leadership. Both A.W. Hickman (the "Young Governor") and his brother, Edward Hickman, ably served their father's business both during his lifetime and afterwards.

Charlotte Erickson, speaking of the industry at national level, stresses the considerable interchange of knowledge within Britain itself at "the top management level, for experience in more than one firm was customary among the men associated with the introduction of new processes".(54) Unfortunately, this was generally not the case for the Black Country. Because the area's fame was associated with wrought iron, and not steel to any great extent, very few "new" men came into the area.

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(51) C. Kirchhoff, Notes on Some European Iron Making Districts: A Collection of Letters to the "Iron Age", 1900.

(52) H.H. Campbell, op cit, p. 421.

(53) Proc. S. Staffs., 1895-6, pp. 38-9.

(54) C. Erickson, op cit, p. 170.

An exception was Enoch James, formerly of Dowlais, who left the South Wales firm to become general manager of Patent Shaft and Axletree Company, Limited (one of the few major steel firms in the area in any case). It was James, for example, who was entrusted by the BITC to prepare the section on "The Steel Works Plant and Equipment of the United States" in the 1902 report on "American Industrial Conditions and Competition". If the South Staffordshire area was not attracting new men to its managerial ranks, it was also losing them. One typical member of this nineteenth century version of the 'brain-drain' was Henry Grey. Born in Dudley, Grey went to the United States and became manager of one of Carnegie's works. In the early 1900's, Grey was actively engaged on the European Continent. At Differdange, in Luxembourg, he built a mill "capable of turning out 50 tons of 14-inch girders per hour". Another, more exalted, person to leave the Black Country and not return was Benjamin Talbot (1864-1947). Talbot's father, a native of Brierley Hill, had moved to the Castle Ironworks, Wellington, Shropshire, and it was from there that Benjamin went to the United States in 1890. He worked in steelworks in Tennessee and Pennsylvania, before returning to the United Kingdom in 1901. Whilst in America, Talbot perfected the tilting furnace which, apart from its rapid production features, was particularly suited for working low grade pig irons. Talbot became managing director of the Cargo Fleet Iron Company in Middlesbrough, and it was there that his process was first developed in Britain. This loss in personnel to the South Staffordshire district was, indeed, made worse by the departure of some of the larger firms to coastal sites. Lysaghts, for example, although they initially used locally-trained men in the management of their Wolverhampton works, had, by the closing years of the century, brought in members of the Bristol group. The departure of the firm obviously included the loss to the area of men like W.R. Lysaght.

If we accept the argument of Professor Habakkuk regarding the position of management in the "Great Depression" then we can say that the situation

in South Staffordshire of overall decline in the iron and steel industries was a cause of the shortage of first-class industrial leadership rather than a result of it. Taking this line of argument a stage further it can also be said that local leaders of the industry like Sir Alfred Hickman were prevented by the location of their works in a depressed area from displaying their talents to the full. In other words, if Hickman had occupied a position similar to that which he held in the South Staffordshire area in Middlesbrough, then he would have dominated an industry undergoing expansion perhaps even more successfully than ironmasters of the calibre of Sir Lowthian Bell.

Reference has been made to Professor Turner's requests for the local industry to give encouragement to the provision of higher education and then to find employment at managerial levels for the products of the university colleges. Ebenezer Parkes, on a number of separate occasions, developed this theme to the South Staffordshire Institute in the further light of his experiences in the United States. As a member of the BITA's team to visit the United States and investigate its iron and steel industries, Parkes had been greatly impressed by "the class of managers they have in the works..."(55) Generally, they were men with a college or university background who had then "come into a works at, say twenty or twenty-one, (and) had several years practical experience as assistant to a manager, and finally they had developed into managers and superintendents at a very early age". Parkes was surprised at the degree of responsibility given to the young manager. He commented:

"We have not a race of managers like that; but, with the spread of education, technical institutes, and, above all, a desire for self-improvement, there is no reason why in the near future we should not have a similar class".

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(55) Proc. S. Staffs., 1901-2, p. 93.

He also suggested that Britain had to get away from thinking that "age and long experience" were "the only qualifications for successful management". In fact, there is no evidence to suggest that this development did take place in the Black Country before 1914.

## Chapter 6 Specialist Aspects of Industrial Management.

Although information is scarce on the subject, it is fairly safe to say that not a great deal of progress was made in the South Staffordshire district with regard to specialist aspects of industrial management. Previous reference has been made to the realisation by some local works' managers of the need to establish more direct control over labour. In the three larger steel plants, the installation of fairly expensive equipment for the production of steel necessitated continuous attendance and even round-the-clock working. Sub-contracting or team-working was not really suited for the new steel processes. Very gradually, centralised management came in, although the slowness in the growth of any real supervisory class was a serious hindrance. Even in very recent years, two of the three steelworks still displayed evidence of the retention of sub-contracting.(1) Without the employment of centralised management techniques, it was impossible, for example, to develop departmental accounting. Parkes had found this to be one of the key-points of the successful production methods of the larger American works:

"The perfect order and system observed in American works is another notable feature. The system of returns, and results of work, in different departments, either in mills or in engineering shops, is carried out with a completeness and a correctness which leaves nothing to be desired. The department of statistics and costs is worked up

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(1) On a personal visit to one of the works a companion and myself were warned by an executive of some standing to be very careful in how we dealt with the elderly person in charge of the patternshop. He was only the fourth person to occupy that position in the whole lifetime of the works and, despite a number of changes in ownership and the growth of management, the head of the pattern shop remained a closed appointment and functioned separately from the rest of the works.

to a high degree of efficiency, and in a well managed works it is marvellous to see the celerity with which they can put their finger upon each different department and know all about it ..."(2)

It is very doubtful, indeed, if anything other than very rudimentary accountancy methods were adopted in the South Staffordshire area before 1900, especially amongst the smaller firms. A number of firms that failed in the period under review displayed staggering weaknesses in this field. Dr. Warren quotes the example of a plate worker and galvaniser who "had neither purchase ledger nor cash book"(3), whilst the Gospel Oak Company of Tipton kept no profit and loss account. Often, so-called 'Account Books' were simply records of whatever nature the secretary of the company thought might be worthwhile putting down. Such a book belonging to Lloyds, Foster and Company contained frequent references to firms which had gone under owing money to that company. How Black Country firms arrived at their quotations (tenders) for specific jobs would make interesting reading. Benjamin Gibbons, for example, a man whose life-span in Black Country industry covered nearly fifty years, seemed to keep his 'facts and figures' on any scrap of paper that was available.

Another aspect of management which failed to develop along lines sufficiently flexible to deal with a changing scene concerned marketing and sales techniques. The advent of severe foreign competition, both at home and abroad, made the situation desperate. Furthermore, market conditions continued to change, not least because of the speeding up of the means of transport and communications. Before the advent of the telegram, for example, the transatlantic, colonial and even the nearer European markets usually performed to a set pattern. Orders followed a

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(2) Proc. S. Staffs., 1901-2, p. 95.

(3) K. Warren, *op cit*, p. 38.

seasonable pattern; the travellers returned with them and orders were placed with the manufacturers who either met the orders from stocks or from sustained bursts of production. In the 1850's, 60's and even 70's, delivery of the greater part of bulky and heavy goods was made by sailing ship, because of the lower freight as compared with the high rates charged by the steamships. It was estimated by Messrs. Bolling and Lowe(4), in fact, that ten per cent of Britain's total exports of iron and steel at any one time was aboard ship. Uncertainty of arrival was a further factor which caused foreign buyers to keep heavy stocks of goods:

"... but every year, and even in every month, changed the position, and now we calculate the quantities on the seas do not amount to five per cent of the total export".(5)

Large stocks of iron and steel goods, with the possible exception of pig iron, were no longer held. Orders could be placed by telegram if necessary, and the fast and frequent mails made it unnecessary to order in bulk. Manufacturers had to be ready, therefore, for the moderately-sized order and to deal with it promptly. In such circumstances, it was becoming of increasing importance to have experienced selling agents on hand in the main overseas markets if sufficient orders were to be obtained to keep the manufacturing plant at economically sound production levels. As early as 1881, a British consul in Latin America had praised German merchant houses in Mexico, and had suggested that British goods sent to Mexico from Manchester, Birmingham or Sheffield were ordered chiefly by German and other merchants. Obviously, when German firms were able to produce the goods required by Mexican customers the orders would not go to British firms.

In the finishing trades of the Black Country the factor or merchant

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(4) Formerly William Bird and Company, London Merchants, founded in 1827.

(5) Annual Report on the state of the iron and steel trades, published in Iron, 22/1/84.



had acquired considerable influence over the manufacturer; in fact, the latter was very often totally dependent on the merchant. In a great number of cases, it was the merchant who employed the travellers; only when the travellers had returned from their journeys would the merchants place their orders with the manufacturers. This almost complete dependence on the merchant by the producers can be seen in the following comment made upon the state of the trade in the local area in July 1884:

"The return home of the travellers to South Staffordshire results in a diminution of the orders arriving at the hard-ware manufacturers. The merchants have not yet either begun to operate freely since the warehouses were closed for stocktaking".(6)

Pointing in the same direction, if slightly different in cause, was a comment made by a member of the Council of the Wolverhampton Chamber of Commerce in 1894 on the state of the district's staple trade - the iron trade:

"Prices were never lower.... The tin and japan trades had been experiencing a hand-to-mouth existence, and goods had been ordered one at a time, and to a large extent by parcels post".(7)

As was the case with the other important centres of iron and steel production, South Staffordshire came to rely a great deal on London merchant houses. Messrs. Bolling and Lowe was, in fact, an example of the more imaginative merchant house, although it must be stressed that such firms did not represent any particular manufacturer or area. They frequently tendered for contracts in competition with the large international firms (John Cockerill, Fred. Krupp, Vickers, Ebbw Vale), and, if successful, they either met the orders out of stock or placed them throughout the various iron and steel producing districts. Furthermore, because merchants and merchant houses acted increasingly on an international

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(6) Iron, 4/7/84.

(7) Minutes Books, entry for 9 May 1894.

scale, it was not unknown for those houses with considerable interests in the Black Country to go outside the district and place their orders for overseas shipment. In shipping iron and steel goods to India or the Far East, Continental firms were frequently able to offer lower prices f.o.b. a major English port than Black Country producers. As well as providing a very detailed catalogue of iron and steel goods for sale, Bolling and Lowe provided the industry with an abstract of details of tests for steel plates, angles, tees, etc., as well as conversion tables for prices and measurements. Of great value, too, was the series of "Reports on the Prospects of the Iron Trade", some of which were published by the trade journals such as Iron. The calibre of these reports was extremely high.(8)

Gradually, the larger firms in the various branches of the South Staffordshire industry began to set up their own selling agencies. Lysaghts and Stewarts and Lloyds (an amalgamation in 1900 of the Glasgow firm of A.J. Stewart and Menzies Ltd. and Lloyd and Lloyd Ltd. of Birmingham and Halesowen) were just two of these firms to establish agencies throughout the main markets of the world, and notably in Australasia, South Africa and Canada. Some small firms, John Knowles for example, were well rewarded for paying similar attention to marketing factors. Nevertheless, despite individual successes Parkes was fully justified in 1901 in complaining that British goods suffered from lack of advert-

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(8) In their 1884 report, Bolling and Lowe had seen the danger of keeping large stocks of pig iron in Connal's stores in Glasgow and Middlesbrough. They put the stocks at one million tons. They were "never encroached upon to any great extent. Taking the value of this at only 40/- a ton, we have a figure of £2 million, on which the dead charge of interest alone, at 4% per annum, gives £80,000 exclusive of all other expenses". The Black Country also knew only too well that a slump in Scotch and north of England warrants could have a disastrous effect on pig iron prices on the Birmingham Exchange. Bell told the Wolverhampton Chamber of Commerce as much in 1889. (Entry in Minutes for January 1889).

ising and the absence of "suitable agents to dispose of them". One member of the South Staffordshire Institute, H. Parry, went so far as to criticise "the capitalists" of the district for their failure to appoint commercial representatives on a scale similar to that of the Germans. In any case, the German firms were soon to establish central selling/marketing agencies in Britain which were to be exceptionally active in the Black Country. One of the reasons for the success of the United States steel firms in the years after 1898 was the use of aggressive selling methods in the main British and overseas markets. The Black Country, indeed, contributed to the appearance of "commercial backwardness" in the closing years of the nineteenth century.

The question of official government support and information about foreign markets for local manufacturers had frequently been raised in the Council of the Wolverhampton Chamber of Commerce. As early as November 1881, the town's member of parliament, Villiers, was instructed by the Council to raise with the the British Government the question of diplomatic representation in Mexico. Their reason for doing this was the help which the German and French iron and steel industries had supposedly received there from their diplomatic representatives. To some extent the local Chamber of Commerce was following a course of action stimulated by the amount of attention given to the subject by The Times; that newspaper had informed its readers, in tones of righteous indignation, that foreign governments (notably the German) were using their diplomatic service to exert pressure to secure special trade favours for their nationals. A few years later, the Council requested the Foreign Office to ask the various consular officials "to embody in their reports any information on the subject of foreign trade which may be likely to serve the interests of British manufacturers" (9). In fact, the Foreign Office

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(9) Minutes Books, entry for 12 December 1884.

took up the suggestion, and the Council was pleased to report on another occasion that consuls in China were to send details "of the exact requirements of Chinese consumers". In 1886, the Black Country lobby decided to bring the whole question before parliament and McLaren, member of parliament for Stafford, moved for the Government to consider the advisability of appointing special diplomatic agents in all foreign capitals "for the express purpose of promoting the extension of British commerce".(10) The Under-Secretary, Bryce, stated that "it was now acknowledged within the Foreign Office that one of its clearest duties was to promote the interests of British commerce to the best of its power by all legitimate means". However, ten years later when G.N. Curzon, then Under-Secretary of State at the Foreign Office, addressed the Wolverhampton Chamber of Commerce it would appear from his remarks that not a lot had been done in the intervening period. Curzon attempted to reassure the local industrialists that the Foreign Office could play a great part in helping them, especially if they were to be able to compete with "the foreign Government backed trade".(11)

If the local industry had failed to make much headway with marketing and sales techniques, at least it had spent a great deal of energy in trying to influence markets and prices through trades associations. As was the case with the other main iron producing areas in the United Kingdom, the South Staffordshire pig iron producers had had a long history of measures dealing with the state of the local industry. The South Staffordshire and East Worcestershire Ironmasters' Association had built up an effective organisation for initiating the numerous statistical battles which it carried out with the railway companies and local rating bodies, and for dealing with the increasing amount of parliamentary legislation. The Association also tried to maintain prices, especially

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(10) Hansard, 3rd. Series, v. 304, pp. 609-13.

(11) Minutes Books, entry for 15<sup>th</sup> January 1896.

with regard to unmarked bar iron.(12) However, by the early 1890's the situation was fairly desperate and in an attempt to avoid complete disorganisation the South Staffordshire and East Worcestershire makers joined with their counterparts from Shropshire, Derbyshire, Nottinghamshire, South Yorkshire and Lancashire to form the Midland Unmarked Bar Association.(13) Quarterly meetings of the Association were held and in Birmingham minimum (basis) prices for the home market were agreed upon. Goods for export were not controlled as far as price was concerned - "All iron which is sold, and delivered f.o.b. in English, Scotch and Irish ports shall not be in any way affected by the terms of this deed" - a point which Macrosty interpreted to mean "economic dumping". In other words, the Association "permitted exportation at reduced prices, the policy which in more recent years has aroused so much resentment when practised by American and German Kartells".(14) The history of the Association was extremely chequered. The first agreed minimum price was £5/5 per ton, which was then quickly raised to £6/10. This latter price, however, was too high in the early months of 1898 and it was lowered to £6; even this was too high and a number of firms found it difficult to uphold against the cheaper bars of South Staffordshire, Shropshire and Welsh firms outside of the Association selling at £5/12 per ton. The

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(12) As their number declined, the 'Marked Bar' houses tended to act together; in effect there was a 'Marked Bar House Association' but, as is related elsewhere in the text, it tended to follow, rather than influence, market conditions. At times of high demand, for example, the speciality iron of firms like Jno. Bagnall and Sons and Brown and Freer, made bigger advances than was general throughout the industry.

(13) In 1898, the Lancashire makers set up their own organisation.

(14) W. Macrosty, The Trust Movement in British Industry, 1907, p. 62.

South Wales coal strike came to the rescue of the Association and by October 1898, agreed minimum prices had been advanced to £6/10 per ton delivered in the district.<sup>(15)</sup> Following the market change, but to some extent acting as a further factor encouraging price increases, the Association fixed the price at £7/10 in July 1899. In fact, very little iron was sold for less than £8 and this was soon made the basis price for iron delivered in the district. It was observed in November 1899 that the Association was "holding together much better than was formerly the case, the circumstances which favour greater cohesion being increased local consumption with decreased competition from North Staffordshire and Wales".<sup>(16)</sup> At its meeting in April 1900, the Association fixed the price at £10/15, which was the highest price for a very long time.<sup>(17)</sup> This, in fact, proved to be the peak; soon afterwards, Scotch, north of England and Lancashire firms began to sell heavily in the Black Country and by September of the same year, when the Association was still adhering to the basis of £10/15, individual member firms were known to be selling at £9. At its October meeting in the Great Western Hotel, Birmingham, the Association reluctantly lowered the basis price for ordinary sizes and qualities by £1 to £9/15. Six months later, the basis price was down to £7 delivered and, with firms accepting £6/10 to £6/17/6, the Association was in ruins.

List prices remained in abeyance for the next few years, with manufacturers accepting the best terms which they could get.<sup>(18)</sup> Slightly improved conditions, early in 1904, saw the "resuscitation" of the Unmarked Bar Makers' Association, and a minimum price was fixed at £6 per ton at the works. However, trade conditions took a turn for the

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(15) Colliery Guardian, 14/10/98.

(16) Colliery Guardian, 10/11/99.

(17) In 1889 - 90, for example, unmarked bars had sold for £8/10, but thereafter a decline had set in.

(18) Colliery Guardian, 30/10/03.

worse and no summer quarterly meeting was held by the Association. There was little cohesion amongst member firms but in defence of them was the fact that there were few branches of the South Staffordshire iron trade "more exposed to competition both home and foreign", and under those circumstances it was "extremely difficult for the lesser firms to maintain Association prices".(19) When the Association did reappear again, early in 1906, it proceeded<sup>4</sup> cautiously with regard to a price-fixing policy; no attempt was made to raise the list price until prices had actually advanced in the market. Furthermore, the Association recognised the fact that if it raised prices too high foreign competitors would be encouraged to enter the Black Country market as, indeed, had happened in the past. After a few months, foreign competitors did enter the market; there were insufficient orders to go round and, once again, the fourty or fifty makers in South Staffordshire sought their own solutions. When, in 1910, the Association made a final attempt to influence the market, it failed hopelessly because its efforts coincided with an outburst of Belgian dumping of common bar in the district.

Perhaps in part because of the district's many difficulties, South Staffordshire firms in most branches of the semi- and finished steel industry were always to the fore in attempts to control the home market. All three of the major steel producers readily joined in 1910 with Scottish and north-east coast makers of plates and sections to respect each other's 'home' and 'special' territories. The following year, in the face of mounting competition from South Wales and abroad, the scheme was extended in scope; a rebate system amounting to 5/- per ton was introduced. Apart from creating a furore in the trade press, the rebate scheme was not successful.(20) It was now that firms like Hickman's and Round Oak must have felt their very limited position. They were like

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(19) Colliery Guardian, 22/7/04.

(20) ICTR, 22/9/11.

pawns in the real battle between G.K.N. on the one hand and the larger Scottish firms on the other for the domination of the West Coast and Belfast markets.(21)

The galvanized sheet trade in the Black Country had for some time shown interest in a combined effort to control prices and production. Two agreements, the one of 1883 and the other a dozen years later, both failed. Welsh competition and the defection of the leading manufacturers, notably Lysaghts and John Summers, indeed, proved too much for the second Galvanized Iron Trade Association and it collapsed in 1900. Five years later, a national body was set up - the National Galvanized Sheet Association; again, the Black Country firms showed an unhealthy over-eagerness to join the pool. The output of each firm was restricted and the market divided up; penalties were exacted on those who exceeded their production quotas. The formation of the Association coincided with an upswing in the trade cycle, with the result that it is difficult to assess the Association's real contribution to the improvement in sheet prices. Between 1905 and 1907, the price per ton for sheet of a given gauge rose from £10 to nearly £14. When demand began to waver, the pool was forced to reduce its list prices and then to abandon price control altogether. At one time, in July and August 1909, prices were back to £10, before settling down at £11/10. The causes of failure were only too obvious. In the first place, not all the sheet manufacturers had joined the pool; the remaining firms were joined by others (including foreign producers) tempted into the market by the pool's high price levels. The numerous small and inefficient Black Country firms had been largely responsible for the high level of agreed prices; all that the Association did for a while was to feather-bed firms who otherwise would have been forced out of business. Its policies were too rigid and the

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(21) D. Burn, op cit, pp. 342-3, and J.C. Carr and W. Taplin, op cit, pp. 256 et seq.



small firms persuaded themselves that capital investment in new plant was not necessary.

Similar developments took place in the tube trade, which was in fact another branch of the industry in which South Staffordshire could boast a large number of small units.(22) The same situation was to be found in Scotland which, together with the Midlands, was the chief centre of the tube-making industry. Competition between the two areas was fierce, and even within each other relations amongst the manufacturers were often bitter. John Knowles, for example, had built up an extensive export trade, with important customers in Berlin, Hamburg, Cologne (Bosch and Haag for example) and even Johannesburg, but his trading accounts for the period show the topsy-turvy nature of the tube business. Attempts were made amongst the larger tube manufacturers - put at between fifty and sixty in 1907 with a host of lesser firms as well - to form a trade association, but those of 1898 and 1902 both failed. With the exception of one Glasgow boiler tube manufacturer, all the United Kingdom tube firms joined together in a British Tube Manufacturers' Association at the end of 1905. This association lasted until the second half of 1908; for nearly three years there was severe competition amongst the remaining

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(22) An interesting account of one such firm, John Knowles of Wednesbury, is given by the grandson of the founder of the firm, K.W. Knowles, in the Journal of West Midland Regional Studies, vol. 2, 1968, pp. 77-99.

John Knowles at one time worked for the most important wrought iron tube makers in the country, James Russell of the Crown Tube Works at the High Bullen, Wednesbury. He set up on his own in 1850 and in 1867 purchased property in Walsall Street, Wednesbury, for £1,740 from the unfortunate Lloyds, Foster and Company. Two years later, the approximate value of the firm was put at £4,827. Net profits for 1870-71, a boom year, were put as high as £1,391/17/2. John Knowles had then decided to concentrate on tube fittings, and the firm remained in that line of business until it was sold in 1946. No further expansion took place after 1907.

thirty-six or so important British manufacturers. In 1911, another more successful attempt was made at association. Home prices rose by some five per cent and in 1913 a rebate scheme was introduced. Of great relevance to this was the changed nature of the structure of the industry. In Scotland, eight small firms had amalgamated into the Scottish Tube Company, whilst the merger movement which had brought Stewarts and Lloyds into being in 1900 meant that the whole British trade could be greatly influenced by one firm. By 1910, for example, Stewarts and Lloyds' production was about 140,000 tons annually. As well as building up a large export trade, through a system of strong selling agencies especially in Australia and New Zealand, Stewarts and Lloyds benefited as far as market conditions were concerned from the geographical location of its two main plants. The Scottish plant in Glasgow was able to place its products f.o.b. at about a cost of 2/- per ton, whilst the plant at Halesowen in South Staffordshire was centred next door to the largest home market for the British tube trade - Birmingham. The German industry, "whose works were on the whole larger and better equipped and more modern than ours", had naturally cornered the larger share of the Continental inter-state trade, but they could not compete consistently with Stewarts and Lloyds in the main British markets.(23)

When Ebenezer Parkes raised the question of American trusts before the South Staffordshire Institute in 1901 (24), he attempted to show why, in his opinion, South Staffordshire firms could never actively participate in any major trust movement in the United Kingdom. Uppermost in his mind was his conviction that there were no men of "commanding genius and personality" owning a sufficiently large firm in the area

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(23) H. Jeans, "The World's Export Trade in Iron and Steel and its Regulation", Proc. S. Staffs., 1908-9, p. 95.

(24) Proc. S. Staffs., 1901-2, p. 95.

from which base they might have been able to initiate some such movement. Charles Schwab had told Parkes that the American trust was not like the old-type association which had been established "for the purpose of the restriction of output and the fixing of prices". Indeed, it was "an association with one capital, one management, one policy, one control, coordinating all the different classes and stages of production into one united whole, and embracing in its operation transit by land and sea, the possession of steamers, of railway plant and railway lines, and the whole system of production from start to finish". Parkes shrewdly observed that there were very great organisational problems inherent in this new type industrial/commercial structure - over capitalisation for one - but above all was the question of leadership:

"They are pushed along and controlled by the commanding genius and personality of one man, and if a succession of such men cannot be found it is like to go hard with the trust".

Recent writers(25) on American management trends in the iron and steel industry of the late nineteenth and early twentieth centuries have suggested that ironmasters can be divided into three categories:

- a. pre-classical,
- b. classical,
- c. the Carnegie generation.

In the first, the ironmasters displayed outstanding technical, rather than organisational, ability, with the result that their units of production were small. South Staffordshire ironmasters of the calibre of the Gibbons' brothers, Joseph Hall, Addenbrook, to name just a few, clearly fit into this category. The second stage in this development

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(25) A Redlich's American Business Leaders and P. Temin's several works on both the American and British industries are of especial interest.

saw the rise of the capitalist entrepreneur, the ironmaster himself combining technical insight (rather than personal inventiveness), an organising ability and, above all, business understanding. Fewer Black Country ironmasters fit into this category than the first and it is easier to think of examples of men who possessed one or two of these characteristics but lacked the third. Sir Alfred Hickman, however, clearly possessed all three. In his own lifetime, he built up his various interests into a moderately large enterprise; he contributed little that was original in the way of technical advance but at each stage in his company's development Hickman displayed a full knowledge of the technical issues involved. Equally, he was able to manage his works, which, in fact, consisted of a vertically integrated concern. Some of the larger wrought-iron firms could be said to have briefly entered this classical stage. It is doubtful if the Black Country threw up any representative of the 'Carnegie generation', i.e. "captains of business instead of captains of industry". Who in the area can be said to have inherited large-scale plant and equipment and then set out to create "big business" with complicated financial and corporate structure? The Carnegies, Fricks, Schwabs and Gareys of the American industry concerned themselves with industrial rationalisation and the development of transportation systems, "leaving technical jobs to hired technical experts".

It is clearly of some significance that the two leading steel producers in the Black Country - Round Oak and Spring Vale - should not have taken part in any large amalgamation movement in the period under review. They remained local enterprises in every sense of the word although, inevitably, both had to go outside the district for their supplies of raw materials. In 1897, Sir Alfred Hickman brought together his two chief interests - the Spring Vale Steelworks and the Bilston Blast Funnaces. Under the title of Messrs. Alfred Hickman Limited, the company controlled a number of subsidiary enterprises, notably E.N. Wright Limited (35,000 out of 50,000 £1 shares), a neighbouring iron and steel

plant erector at Bilston, and the Oxfordshire Ironstone Company Limited. The Ironworks included part of the former Cappon Field Furnaces and Colliery which Hickman had in fact purchased in 1881 from Richard Bagnall. From 1905 onwards, too, Sir Alfred was chairman of 'Tarmac Limited'(26). He had also possessed a sizable personal holding in the Chillington Iron Company, once a very important ironworks, but by the twentieth century concerned mainly with the manufacture of edge tools. The third steelworks in the district, the Patent Shaft and Axletree Company, did lose its separate identity in 1902 when it was incorporated with the Metropolitan Amalgamated Railway Carriage and Wagon Company Limited (Metropolitan Carriage, Wagon and Finance Company Limited in 1912).

The growth of amalgamations in other branches of the iron and steel industry in which South Staffordshire firms played a part have been recorded elsewhere in detail and here need only be mentioned briefly.(27) In the tube industry, where home and foreign competition was, indeed, severe, the Scottish firm of Stewarts and Menzies joined forces with Lloyds of Staffordshire, thus making a firm with an issued capital of £1,750,000. H.W. Macrosty described the formation of Stewarts and Lloyds as an attempt to achieve "the extinction of competition" - "One might say that there was the embryo of an 'efficiency' trust which contemplated the extirpation of its rivals".(28) The largest screw manufacturer in the Midlands, Messrs. Nettlefolds of Smethwick, featured in one of the most important amalgamations of the early 1900's. Although a number of

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(26) For further details on how Sir Alfred Hickman acquired "The Tar Macadam (Purnell Hooley's Patent) Syndicate Ltd" see G.R. Morton and M. Le Guillou, loc cit, pp. 17 and 19.

(27) Dr. Warren for details of the sheet manufacturers and C. Erickson for a number of examples of mergers.

(28) H.W. Macrosty, op cit, p. 46.

leading South Staffordshire figures had tended to view with alarm the decision of Nettlefolds to move their iron and steel-making interests to a coastal site (through acquisitions in South Wales)(29), the creation of Guest, Keen and Nettlefold in 1902, with an issued capital of £4,500,000, had important results for the Black Country. Before the outbreak of war in 1914, various other Midland firms had joined the group, which then controlled mines, blast furnaces, steelworks, rolling mills and engineering plant.

When the management problems of the Black Country iron trade were discussed by members of the local industry, as sometimes occurred at meetings of the South Staffordshire Institute, a number of managers were not fully prepared to accept criticisms implied of them, unless they were put in their proper perspective. H. Pilkington, for example, stated on one occasion that managers and men "were what they are" because they were so made "by the capitalists or by the boards of directors, or the owners who employ them".(30) Pilkington went on:

"The day has arrived when we should have to consider what the requirements of the times are among owners of works, among boards of directors, among the financial men who have the supreme control over our works. The time for ornamental directors have gone. The time for guinea pigs has gone also. The time has arrived when those who are in supreme control over our great iron and steel works shall be men who have some real connexion with what they are supposed to do. They ought to be men of real financial and engineering or commercial abilities, capable of understanding their people's experiences in the

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(29) Professor Turner believed that Nettlefold's move threatened the area with extinction, Proc. S. Staffs., 1901-2, p. 158.

(30) Ibid, p. 93.

works and in their difficulties".

Another contributor to the same discussion was firmly of the belief that the area did not suffer from either inferior workmen or managers, but from owners who were unprepared to risk their capital on new machinery:

"Our great misfortune is that we are working with old tools and the old machines. If our capitalists would lay out works upon modern lines and put Englishmen to work them, I think we could get as good results out of them as anyone. However well you may instruct the youth of this country, if you turn them into badly laid out and poorly equipped works, you can never expect to get good results".

It was clear from what many of the managers had to say that they were not in authority in the works which employed them. The direct management of a typical South Staffordshire works differed from its American counterpart in that the latter really controlled matters. American directors regarded improvements as inevitable:

"As for the stockholders, they are not supposed to inquire into details. In England they rise at the annual meeting and ask questions as to the money spent on new work and the returns derived therefrom, and if American managers were subject to this inquisition they might live a less forceful life. In England, improvements are not made

from profits, but new capital is authorised when deemed necessary".(31)

At the meeting of the South Staffordshire Institute which had discussed the BITA's report on Germany and Belgium, Moses Millard had expressed dismay that whilst the Institute had done "its best to point out improvements, and have called attention to everything that scientists have suggested, yet up till now the Midland ironmasters have not taken up the various proposals which the managers have put to them". Millard

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(31) H.H. Campbell, *op cit*, p. 102.

gave an example of the way the ironmasters backpeddled on the matter of capital expenditure:

"A master admitted to me some years ago that certain machinery was getting antiquated, and on my pointing out to him that a saving could be made if he went to the expense of putting down new plant, he said, "Yes, it's all very well, Millard, but it will serve my time"".

Jno. W. Hall went some way towards explaining the position of the ironmaster on the question of capital expenditure. He painted the classic picture of the ironmaster in the period of the 'Great Depression', putting down new machinery to get better results only to see the price of the product in question go on falling. Hall quoted the occasion "when a certain steelworks was inaugurated, and I had a little to do with it":

"At that time steel rails were quoted at £22 per ton. A little later on I saw some rails rolled off at £19/10. The last rails were rolled off at £4/10. The works were stopped and it is said that the proprietors lost half a million of money .. "

If new equipment was to be installed was South Staffordshire the best location? Hall raised this very important factor when he recounted the view of a "very enterprising" local ironmaster:

"Supposing <sup>if</sup> we were to effect them, I have no certainty that I shall be any better off in the end, and if these alterations have to be done at all had I not better at once move to the sea coast?" (32)

It is difficult to reach a decision on the issue between managers and masters (capitalists). (33) On the one hand, South Staffordshire

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(32) Proc. S. Staffs., 1895-6, p. 120.

(33) T. Burnham and G. Hoskins, Iron and Steel in Britain, 1870-1930, 1943, p. 271. The authors of this book state categorically that the United Kingdom iron and steel industry would not have declined so fast but for the shortcomings of "those at the top".



management could be described as ordinary and unenterprising but, nonetheless, efficient. By British standards the local managers were average; by American standards they were over-cautious, too content simply to remain as good as the next in the district. They certainly would not have satisfied the prominent American ironmaster quoted by Axel Sahlin in the 1902 Report on American Industrial Conditions:

"We want a manager who not only keeps our works going, looks after men and plant, and repeats to-morrow what he did to-day, and next year what he did during the last; we demand of our manager that he looks ahead, watches and keeps us informed of the trend of the times, and the progress daily making in our industry; that he devises means and methods to meet altered conditions, and to keep our business in the front rank. It is not enough that he works up to the level of others. He must constantly endeavour to do a little better, accomplish a little more, save a trifle here, improve a detail there. As for the blast furnace manager who has not learnt more during the time his furnace has been working than to put it into blast again, after repairing it on the same lines as last time, without seeing his way to improve, to strengthen, and to make more effective his furnace; we have no use for that class of men".(34)

Equally so with the masters. To listen to their representatives discussing, together with the managers, the main issues affecting the state of the iron and steel industry of the day one could be excused for thinking that they were really enthusiastic for new ideas and aware of the need to keep abreast of change. No man, through word of mouth, promised to do more for the local industry than Ebenezer Parkes, and yet, as Duncan Burn points out, having criticised British industry for

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(34) American Industrial Conditions and Competition, Reports of BITC, 1902, p. 500.

not having "sufficient pluck ... in scrapping old and effete plant", he had himself "just started a new works whose power unit was an old beam engine reassembled on a new site".(35) Similarly with Sir Alfred Hickman, much of the machinery installed in his own works was either second-hand or obsolete. His saving characteristic was his almost German ruthlessness in the way he sought after economies in production through the utilisation of by-products.(36) In sharp contrast, too, with American ironmasters, was the tendency for the more important local industrial figures to seek careers in politics. Both Parkes and Hickman became members of parliament and were prominent figures in local politics as well. In the absence of outstanding management at the lower levels, their lengthy periods away from their works must have had a poor effect. It was not without significance that J.S. Jeans, in the company of Parkes, should have found it worthwhile to remark upon the lateness of the hour worked by "the responsible superintendants or managers of works - as, for example, the Duquesne Works of the Carnegie Steel Company".(37) It is doubtful, too, if the local South Staffordshire ironmasters would have agreed with Schwab's comment to Sahlin:

"We pay high salaries because it is economy to do so. A good income attracts first-class men, and such a man will earn his salary over and over again".(38)

Technical or scientific management was especially poorly rewarded in the United Kingdom industry; head chemists, for example, would not re-

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(35) D. Burn, op cit, p. 296.

(36) "His ironworks are models, for he emulates the Germans in the application of science to industry, and in the utilisation of the valuable residuals of iron manufacture", The Wolverhampton Journal, March 1905.

(37) 1902 Report, p. 75.

(38) Ibid, p. 500.

ceive more than £100 per year.(39)

Weaknesses were to be found in the composition of local Boards of Directors. As was common with much of British industry, the local iron and steel industry had its quota of examples of nepotism, of the appointment of men who knew little or nothing of the industry, of the continued presence of men long past their prime. Little of that "industrial potentiality" found in America by the British Iron Trade Commission was to be seen in the South Staffordshire area at the Board of Director level. The fortunes of the Earl of Dudley's Round Oak works in the early 1890's illustrate the lack of confidence on the part of the investing public in Black Country management. When the Earl sold the works to the Lancashire Trust and Mortgage Insurance Company, there were few men on the Board with any experience in iron and steel making; by July 1894 the affairs of the company were desperate. In an attempt to stave off disaster, a number of leading local managers and masters were brought in, including Francis Grazebrook and James Roberts. In vain, the company went into liquidation in November 1894.(40) George Hatton survived from the company's crash to become Managing Director of a new Round Oak company which was formed in July 1897. This time there was no attempt to seek capital from the general public; a few members of the Earl's business friends subscribed, including the Birmingham engineer, Alexander Smith. Excluding the Earl's agent, G.H. Claughton, there were two solicitors on the Board, J. Tryson and C.H. Saltwell. In fact, members of the legal profession were generally important investors in the local industry, without, of course, knowing much about the nature of iron and steel production. A solicitor from Oldbury, by the name of Shakespeare, owned

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(39) J.I.S.I., 1896, p. 119.

(40) Collie Knox, Steel at Brierley Hill, 1857-1957, 1957, pp.71-3, especially the section "People and Dates".

extensive ironworks at Frodingham in Lincolnshire; perhaps no Black Country ironmaster was interested in acquiring additional plant because it was reported in the trade press in 1907 that the works had been sold to the Sheffield firm of John Brown and Company for £100,000.(41)

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(41) Colliery Guardian, 5/7/07.

Chapter 7 : South Staffordshire and the Growth of Foreign Competition,  
1850-1914.

The poor showing of the United Kingdom iron and steel industry at the Paris Exhibition of 1867 deservedly resulted in The Times taking the English producers to task.(1) Almost for the first time, the general public became aware of the fact that there were foreign competitors in the iron trade. Two public enquiries - one into the state of scientific instruction and the other into the Trades Unions - were also started in 1867 and they provided the opportunity for a great deal of evidence to be collected on the state of the iron industry at this particular juncture. Besides, the public was looking for a scapegoat as a result of the collapse of speculative industrial developments of the previous year. Although of very small proportions, Belgian iron imports had appeared in the United Kingdom markets in the promising year of 1866 and, perhaps even more significant, they grew slightly in the next three, rather poor, years. It was remembered, too, that during the panic of 1857, Belgian iron manufactures had entered the foreign field in competition with British ironmasters. In 1859 and 1860, British makers had lost contracts to a Belgian syndicate for the supply of iron rails to Spain, Switzerland and Holland, not to mention the supply of Belgian locomotives to Russia in the 1860's. Considerable attention was paid by the two public bodies

<u>Year</u>	<u>Imports of Belgian Rolled Iron into Britain (£.)</u>	<u>Total Imports of Iron &amp; Steel (£.)</u>
1866	103,000	-
1867	135,000	1,498,000
1868	146,000	1,331,000
1869	124,000	1,335,000

to the question of labour costs in industry; inevitably, it was suggested by witnesses that labour costs were high in Britain because of the actions of trades unionists and that the price of English iron had risen to the point when foreign iron could be imported into the country and sold in

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(1) The Times, 29/5/67.

competition with the home product. Having secured a foot-hold in the English market, Belgian iron "could not be beaten back again".(2) What particularly caught the public's attention was the quantity of iron girders which came from Belgium, especially when they were used in the building of both St. Thomas' Hospital and the South Kensington Museum. Buildings in Sheffield, Middlesbrough and Glasgow also had Belgian girders in their structures. It was suggested in the later sixties, and again to Lowthian Bell by the Royal Commission in 1886, that the reason why this had taken place was because the Belgians' "science and practice ... was infinitely superior to what they were in our own industry".(3) What seemed to be worse in the eyes of the critics was that the Belgians were reported to be using pig iron imported from Middlesbrough. Bell, in fact, was able to put the record straight in this instance: "no iron is ever sent from this country for conversion into girders" - but the presence of Belgian girder iron remained in English markets.(4) Benjamin Hingley, for one,

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(2) S.C. on Scientific Instruction, 1867-8, M.E. 10,939.

(3) Royal Commission on Depression of Trade, 1885-6, M.E. 2151.

(4) Bell was no doubt correct in saying that Belgian producers of girders had been able to gain a good home market - as well as one in Germany - because continental architects and engineers had for some time advocated their use for the structures of buildings: "The demand for this form of iron became so large that it paid the masters to keep a large stock, out of which orders could be supplied without delay". W.A. Donaldson, an ironmerchant of Glasgow and Middlesbrough, thought that British ironmasters had simply preferred to make angles or ship plates, for which there was a readier market: "now ... they have turned their attention to girders, and I believe that they are successfully competing with Belgium in girders". Ibid, M.E. 2578. In fact, this view was far too optimistic. When English producers did, in fact, turn their attention to 'girders, beams and pillars', they found it very difficult to win orders from customers who had found Belgian iron very satisfactory.

admitted in 1881 that the South Staffordshire ironmasters had tried to compete with Belgian girder iron but had failed.

All thoughts of foreign competition subsided in the boom of 1871-73, although it was again noted that the high prices which then prevailed were sufficient to bring Belgian iron on to the Birmingham market in competition with the local product. Once the boom had ended, much more attention was given to the continued presense of Belgian iron in the British markets, even if was thought by some that it did not mean that the Belgians were selling much above cost.(5) South Staffordshire iron-

Total Belgian Exports to Britain, 1872-75

<u>Year</u>	<u>Tons</u>
1872	27,316
1873	13,293
1874	34,713
1875	33,662

masters were not much concerned over Belgian exports of rail iron (they had long ago given up this branch of the iron trade) but they were alarmed at the extent of Belgian competition in plates and sheets, anchors and chains, nails and various other articles of wrought iron. For example, Belgium exported about 70,000 tons of 'plates' in the period 1873-75, and over 33,000 tons of nails, two items for which the Black Country had an established reputation. In 1875, W. Farnworth, manager of the iron and tinplate works of E.P. and W. Baldwin, visited ironworks in Belgium to see for himself why the Black Country was having to face such competition.(6) He was impressed with the high quality of Belgian steel and the "great economy" which resulted from running the metal "from the blast furnaces direct into the converters". However, he was also of the opinion that if the managers of South Staffordshire were "to use unflaggingly all their skill, tact and energy to produce good iron at the cheapest possible rate" they would have little to fear. They could expect fierce competition

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(5) Select Committee on Railways, 1881, p. 250 and Royal Commission on Depression of Trade, 1885-6, M.E. 2485.

(6) J.I.S.I., 1875, i, p. 247.

from Belgium in the markets for common qualities of iron, but little in the market for superior quality iron. Whilst he had found that Belgian girders were "particularly good", Farnworth had much to criticise with regard to rails and sheets. Spokesmen for the Belgian industry took issue with him on this, and the editor of the Moniteur des Interets Materials pointed out that Belgian rails and sheets were both used in a number of markets in preference to those made in England - the London market had even been supplied "with several hundred tons of fancy sections of bar iron, at prices below those of Staffordshire, and the quality of which has never called forth the slightest complaint on the part of the buyers". Farnworth, who had already addressed the South Staffordshire Mill and Forge Managers Association on the subject, spoke to them a second time on Belgian competition, and this time he was strongly supported by a 'Mr. Adams' of the Mars Iron Works, Priestfields, who said that "he had seen, in London, some Belgian sheets for galvanizing purposes, which were so inferior in quality that he pricked several holes in them with a pen-knife". Farnworth conceded, however, that the Belgians had certain advantages over the Black Country; these included cheaper labour and easier access to raw iron from Middlesbrough and superior ores from Spain.

Despite the rather superior tones adopted by South Staffordshire ironmasters to Belgian iron, an increasing amount was sold to customers both in the United Kingdom and in neutral markets. A British Consul in Florence commented in 1877: "It may be that the quality of foreign steel is inferior ... in any case the article seems to satisfy the purchaser".(7) The Consul was referring specifically to railway material in the Italian market, but his views were equally applicable right across the board. A writer in The Times spoke of the "apprehensions of foreign competition" haunting the British manufacturer; this was certainly true of South Staffordshire ironmasters. Late in 1877, the very old firm of G.B. Thorney-

(7) Accounts & Papers, 1878, 35, p. 1389.



croft (8) closed its doors and amongst the reasons given publicly by Thorneycroft was foreign competition. By 1881, "hundreds and hundreds of tons" of Belgian wire were selling on the Birmingham market, together with Belgian nails, at prices substantially lower than those quoted by the local producers.(9) The same was true on the London market, even though it was generally accepted that production costs in Birmingham and Belgium were the same. The sheet industry was even feeling the effects of Belgian competition in Australia where, in 1881, the latter country had gained a prize medal for galvanized sheet.

Belgian competition continued to disturb the Black Country industry in the early and mid-eighties. It was described as "severe" in November 1881, especially in "light wares" which could be transported in to the Midland markets.(10) What was especially significant about the extent of Belgian competition with the Black Country in the early part of the decade was the fact that in general the period was one of satisfactory progress for the British industry. The railway boom, which began in the United States towards the middle of 1879, soon became world-wide in scope and no threat was seen in the increasing continental iron exports when British plant were refusing orders.(11) As suddenly as the general situation had improved, however, it disappeared in 1883 with the almost

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(8) The closure of this firm was especially significant in that the Thorneycrofts had taken over premises formerly owned by John Wilkinson. One of the brothers had worked with Addenbrook at the latter's Moorcroft Works - the Thorneycrofts firmly linked their generation of ironmasters with those of the first industrial revolution era.

(9) Select Committee on Railways, 1881, M.E. 11,547 and 10,943.

(10) Iron, 2/11/83.

(11) In periods of high demand, British producers often failed to meet the requirements of the home market; promised delivery dates were not kept to or, simply, foreign suppliers could promise immediate delivery of goods required. This failing of the home industry obviously encouraged British users of iron and steel to look to continental suppliers.

complete falling off of the American market. Despite a continued drop in prices, Belgian iron remained in the world markets, sometimes even improving its position. A number of British consuls remarked upon a "preponderance of Belgium in iron exports". Now it was possible to observe some indirect effects on the Black Country of Belgian competition. Faced with increasing difficulties in overseas markets, better located producing areas in the United Kingdom, notably South Wales and the north-east, found it convenient to increase their sales to the Black Country or to markets hitherto left largely to Black Country ironmasters. By the winter of 1884, Middlesbrough steel producers were offering to execute orders for South Staffordshire 'middlemen' at "£6/15 delivered in the Thames, as against £7/10 to £7/15 required by Staffordshire makers".(12) The situation simply worsened in the following year when some 225,000 tons of bar and section iron were exported by the Belgians, 55,000 tons coming direct to England. Even Sir Lowthian Bell had to admit that, considering the extent of its trade, Belgium "is the largest exporter - not excepting Great Britain - among iron-making nations". Bell further emphasised that "it is worthy of note that the products sent abroad are disposed of in the very markets to which Great Britain has even a readier access than the Belgian makers possess".(13) When the Royal Commission sent a circular containing a number of questions about the supposed depression of trade and industry to the Wolverhampton Chamber of Commerce it was not surprising that Belgian producers should be mentioned as posing a serious threat to South Staffordshire ironmasters in continental and other markets. Although it was not thought that there was much of a lasting danger in their own local market, foreign competition had greatly affected markets in which "English productions had formerly an almost

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(12) Iron, 14/11/84.

(13) Royal Commission on Depression of Trade ..., 1885-6, p. 349.

exclusive monopoly".(14)

In the early 1890's, when Belgian exports fell by only 20 per cent compared with 40 per cent in British exports, Belgium not only found an annual market in Britain for approximately 100,000 tons of iron and steel goods but she also made further inroads in markets where previously South Staffordshire ironmasters had been successful. Early in 1893, the Belgians had seriously disrupted the market for bridge and girder iron and had virtually driven out South Staffordshire producers.(15) This development was especially unfortunate for South Staffordshire in that she had only just recovered from severe north of England competition.

Imports from Belgium of "girders, beams and pillars"  
1890 - 93

<u>Year</u>	<u>Tons</u>	<u>£.</u>
1890	56,604	404,649
1891	55,433	387,923
1892	49,695	337,697
1893	44,233	283,296

Total Belgian exports to Britain in 1893 = 82,000 tons.

By September 1893, export orders for Black Country sheets, both plain and galvanized, had almost stopped because of competition from Belgian and German companies. Two months later, the same competitors were said to have seriously disrupted the Midland scene again, this time by quoting lower prices (for future orders) for some of the neutral markets: "South Staffordshire merchants had hesitated to place their orders, with the result that Midland iron was almost certainly to be displaced".(16) In the next year, considerable attention was given to the Belgian industry because of the Brussels meeting of the British Iron and Steel Institute. One newspaper correspondent wrote:

"It is not alone the invention of the Thomas-Gilchrist steel principle which has made Belgium what she is to-day. English ironmasters re-

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(14) Minutes Books, Wolverhampton Chamber of Commerce.

(15) Colliery Guardian, 2/6/93. The same source also mentioned the fact that Belgian sheets were coming into the Black Country at "20/- - 30/- below South Staffs. prices".

(16) Colliery Guardian, 28/9/94.

turned from Brussels more than ever convinced that the long hours and low wages and strict discipline of Belgian works has more to do with Belgian success than any other element in the surrounding conditions".(17)

One of the points suggested by the correspondent as a possible solution for the British industry overcoming Belgian competition, namely "reduced freight rates", was recognised as not being applicable to the Black Country. When, in September 1894, complaints were made about the railway companies having granted "preferential through rates to foreigners", it was noted that "the combination of traders" in the Black Country seemed "to be powerless against the overwhelming monopoly of the railway companies".(18) The behaviour of the railway companies had particularly infuriated members of the Black Country iron trade because it was generally felt that the Belgians were already selling common iron and girders at below cost. Throughout 1895, the Black Country had to face continued Belgian competition in a variety of products, the two exceptions being steel and special quality iron. In March, Belgian bars were being offered on the London market "at less money than they can be delivered from Staffordshire", whilst in May the unremunerative state of contracts was blamed on "very severe" continental competition.(19) By this date, however, the threat of German competition was beginning to push that of Belgium into the background.

Although German iron exports had appeared briefly in competition with those from the United Kingdom in 1857, there was to be little further German competition for the next twenty years or so. France and Belgium, rather than Germany, featured in the 1867 'scare' and even the fact that in 1878 Germany surpassed Belgium's quantity of exports went almost unnoticed by both the British public and the industry. The attention given

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(17) Colliery Guardian, 7/9/94.

(18) Ibid.

(19) Ibid, 8/3/95 and 17/5/95.

by informed British circles to the German industry in the 1870's was focussed more on the industry's troubles than on future possible competition. Nevertheless, there were the occasional references to Germany as a possible competitor; in 1876, The Times spoke of "Apprehensions of foreign competition ... haunting us", whilst in the December of that year, the Board of Management of Bolckow, Vaughan and Company sent a letter to the BITA expressing concern about the successes of German ironmasters in securing large orders against British competition in both Italy and Portugal. British consuls, too, in several European countries found it necessary to raise the question of German competition in the iron trade.

Immediately the new decade started, a much keener interest was taken in the German industry. Those who had sided with the view expressed in the Statist about foreign competition having "sharpened the struggle ... (but not) gained largely upon us" were no longer so sure.(20) A letter to The Times in November 1880 mentioned German rail competition in Italy - the German firm of Bochum had won an order for 30,000 tons of steel rails for the Alta Italia Railway - and then went on to draw the public's attention to "the strange and unfair German policy of selling cheaper abroad than at home".(21) In the following year, whilst the British Consul at Helsingfors lamented the fact that it was Krupp who was supplying the Finnish State Railway with rails and rolling stock, and a British representative in Mexico sang the praises of German merchants in South and Latin America(22), R. Heathfield, representing the galvanized iron trade

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(20) S. Chapmen, op cit, p. 64.

(21) Letter from 'Steel', The Times, 23/11/80.

(22) Accounts & Papers, 1881, 33, pp. 397-8, quoted and commented upon by R.J.S. Hoffman, Great Britain and the German Trade Rivalry 1875-1914, 1964 (First Edition 1933), pp. 16 - 17.

of Birmingham and South Staffordshire, was giving evidence before the Select Committee on Railways. He, too, spoke of German competition, this time in Australia; Heathfield was convinced that in the near future even greater German competition could be expected.(23) As the decade wore on, so the references to German competition in the iron trade grew; in November 1884 the matter was discussed in the House of Lords and the words of Sir John Brown quoted: "now former customers have become our competitors, and not only sell against us, but undersell us, not merely in neutral markets, but under our very noses at home". Reference was also made to imported iron being used "for an enormous railway station in the Midlands" and for the construction of bridges. An element of bitterness was beginning to creep into the dialogue, especially from Sheffield traders who spoke scathingly of the fraudulent German use of English trade marks. German ironmasters, too, showed irritation; in June 1883 - a most unsatisfactory year for the international trade in iron - Herr Jacobi, of Sterkade, speaking to the Society of German Iron Manufacturers, lamented the fact that German makers found it so difficult to compete with England in contracts for German shipyards. He estimated, in fact, that about nine-tenths of the material used in private yards was of English origin.(24) A key-point to remember about the 1880's was that, in general, the British

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(23) Select Committee on Railways, 1881, M.E. 10,763 and 10,936.

(24) Hitherto, relations between the British and German industries had tended to be excellent. Both sides kept each other informed over early progress in the basic industry, and even in later years leading personnel from both sides kept up their contacts. Nevertheless, a certain bitterness was creeping in, as an account of British observations on the German industry will make clear.

industry was still far superior to that in Germany. In the three major producing countries - Britain, Germany and the United States - there had been what was described as "feverish excitement" (1879 and 1880) followed by "extraordinary expansion".<sup>(25)</sup> Whilst accepting that the German industry was showing an encouraging sign of recovery from the doldrums of the 1870's, together with the fact that the new tariff afforded her industry a high degree of protection, it is, nonetheless, true to say that the over-

Progress in the Iron and Steel Industry

<u>Country</u>	1866	1873	1877	1882
United King.	4,970,206	6,566,451	6,608,664	8,493,287
U.S.A.	1,603,000	2,868,278	2,314,585	5,178,121
Germany	1,053,260	2,174,737	1,421,667	3,170,957
Total	7,626,466	11,609,466	10,344,916	16,842,667
	* Increase 52% *		* Increase 58% *	

production which occurred in Britain in 1883 had serious effects on the Germans. Economic dumping might not have been pursued by the British industry, but British iron and steel goods were all but thrown on to continental markets, thus forcing Germany for one to pass on the pressure. "It is curious to observe", wrote a leader writer in Iron, "how any movement, up or down, in the English iron trade is first reflected in Belgium and West Germany, from where the wave extends gradually to the Silesian and from there to the Austrian market". Forced, once again, to look for export markets, the German foreign trade in iron and steel actually rose in 1883 (whilst Britain's declined); German goods were now finding markets in South America, the Orient and even in the Colonies, at a time when Britain was hoping to make good her losses to the North American market by increased sales in these same markets. Between 1880 and 1885, Germany's sales to Australia rose from 600 tons to 28,000 tons, whilst to South America there was a rise from 6,600 to 40,000 tons.<sup>(26)</sup>

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(25) Iron, 19/10/83.

(26) D. Burn, op cit, p. 79. Burn gives a detailed account of British and German exports to what he terms the 'privileged' and 'unprivileged' markets.

The stage was thus set for German competition to feature, perhaps a little alarmingly at times, in the hearings of the Royal Commission of 1885 - 6. Evidence from a number of British consulates situated in the world's chief iron markets all told the same story - British retreat in the face of German advance.(27) The British Consul at Hamburg stressed that Scotch brands were losing out to Rhenish producers using Spanish ores, that British gas and boiler tubes had almost totally disappeared from German markets, although tin-plate was still largely imported from Britain. Mulvanny, H.M. Consul at Dusseldorf, feared that British producers had "been resting on their well-earned laurels, and, (had) relied on this prestige"; they had failed to keep themselves informed "as to the progress being made by their neighbours, who are now able to produce better wares". Putting aside the evidence of Sir Lowthian Bell for the moment, some of the best material came from two men - T.I. Smith, director and general manager of the Barrow Hematite Steel Company, and W.A. Donaldson, who represented Messrs. Watson & Company, ironmerchants of Glasgow and Middlesbrough, with branches in Swansea and Liverpool. Unlike Bell, both men stressed the great importance of the basic process in the future threat of German competition. Smith was concerned at the effects which this could have on the West Coast's position in the steel rail trade - he lamented the fact that the agreements reached in 1883 between Britain, Belgium and Germany over the trade in rails had resulted in the Germans being 'given' orders totalling 246,000 tons - whilst Donaldson stressed that even with Spanish ores the German industry had been able to manufacture rails for which they found markets in Canada, India and Australia. Basic steel rails had also appeared in these markets, as well as in the Colonies.(28) Smith observed that in future it was probably true to say

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(27) Appendix Part 11 of Royal Commission on Depression of Trade, 1885-6, pp. 111 et seq.

(28) Ibid, p. 57 and M.E. 2618 - 2623.



that Germany would supply its own market's requirements and much of those of its neighbours, especially along the Rhine. Whilst expecting that there would be increased German competition in other continental markets, he did not think that Germany would be able to get England out from all of them. To the straight question "have you any fear of foreign competition in your trade?", Smith replied:

"We are able to hold our own against foreign competition, and we think that we never could be in a worse position than we have been in during the last twelve months". (29)

Bell's evidence to the Royal Commission was clearly the most detailed and obviously the most widely accepted. Whilst admitting that insufficient attention in Britain had been given to the progress made by foreign producers, Bell was not prepared to accept that Germany posed any real threat to Britain's position in the world's markets.(30) Even the fact that it might be cheaper to send goods to some parts of Great Britain from the continent than "from an English ironworks to the same place", did not seem to Bell to mean any alteration to the fact that Britain held in the neutral markets of the world "the most favourable place of any nation".(31)

The South Staffordshire district, in the early and mid-eighties, still tended to view competition from Belgian works with more alarm than that from Germany. However, Germany was mentioned specifically in the reply sent by the Wolverhampton Chamber of Commerce to the questionnaire of the Royal Commission, and when H.L.Müller and W.W. Lord appeared before the latter body, as representing the Birmingham Chamber of Commerce, they stated that German nails and wire were sold on the Birmingham market at prices below those asked by local producers. Whilst it is true to say

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(29) Royal Commission on Depression of Trade, 1885-6, M.E. 2369.

(30) Ibid, Appendix, p. 343.

(31) Final Report of Royal Commission, pp. viii - ix.

that over the next five years or so the British iron and steel industry experienced a certain amount of prosperity - felt less in South <sup>S</sup>taffordshire than elsewhere - developments were taking place which would result in almost a head-on collision between British and German ironmasters for mastery of the world's markets. By the early 1890's, Germany's exports had entered another phase of rapid expansion; European markets were dominated by her exports, whilst those from Britain were almost totally excluded. Germany's iron and steel exports to Britain rose from 49,000 in 1889 to 121,000 tons in 1894, the latter total valued at £567,142. In that year, The Times spoke of the "Decay of the Iron Trade"(32), and remarked that few people probably knew that "more German iron (was) imported into Great Britain than into any other country except Switzerland, and in the latter case the iron was probably largely in transit for Italy and other countries, while in our own country it had come to stay". The Black Country felt this competition especially in the hardware trades, iron tubes and in galvanized wire, whilst sheet manufacturers complained for the first time in September 1893 of being undersold by the Germans. Some sections of the industry felt humiliated over the passing of British pre-eminence, although there was more than a little satisfaction expressed in the district when it was realised that the tariff war between Germany and Russia was resulting in English firms (including some from South Staffordshire) receiving Russian contracts.(33) When the South Staffordshire Institute discussed the 1896 BITA Report there was also a fair amount of frustrated anger at the German industry. B.H. Thwaite, a notable contributor to discussions at the Institute, had expressed the views of many when he wrote an article in The Nineteenth

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(32) 18/9/94.

(33) Colliery Guardian, 5/1/94.

Century entitled "The Commercial War Between Germany and England".(34)

He concluded the article:

"Englishmen can have no objection to German success, if honestly won, by quality or cheapness of product, itself the result of fairly paid labour. They cannot understand why the German manufacturer, trained in his student days to respect the principles of honour, if need be up to the rapier point, should descend to commercial manouvres that are dishonourable in the extreme".

At the height of Germany's exporting phase in 1893, it was remarked that she had exported 36 per cent of her aggregate make of finished iron and steel; this was substantially in excess of Britain's 32 per cent (40 per cent if tin-plates <sup>is</sup> included). However, for the next five years the boom in her home market largely took German pressure off the export markets and greatly reduced the degree of competition to British goods. Between 1896 and 1900, the Black Country industry only felt the effects of German competition occasionally; in September 1897 it was suggested that the wheel and axle department was suffering from German competition and then in January 1899 the high prices prevailing in the district were thought to have given "an opening to foreign makers and some Belgian and German representatives are in Birmingham quoting for orders".(35) It was in this period, however, that iron and steel imports were first received from the United States.

In 1869, the President of the Iron and Steel Institute told an attent-

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(34) The Nineteenth Century, 1896, p. 930. In fact, in 1896 the culmination of British reaction to German competition was the publication of E.E. Williams' Made in Germany. Hoffman gives a very good analysis of British views at this time, op cit, pp. 242-57.

(35) Colliery Guardian, 10/9/97 and 13/1/99.

tive audience that "the manufacture of iron will be carried on across the Atlantic to an extent never yet witnessed" at some future date; in the meantime, however, the price of labour ensured that there would be "no immediate prospect" of the United States competing "with the iron producing countries of Europe in the open markets of the world".(36) Even in the early 1870's, when the advantages were all on the side of the British, members of the American industry spoke longingly of the day when they would be able to dominate world markets. In 1872, for example, there was speculation in the New York Bulletin that Britain would soon have to get both its coal and iron needs from the United States: "it is in our power to control the iron trade of the world as absolutely - during the next half century at least - as Great Britain has controlled it during the past quarter century".(37) Reports in newspapers of American iron being sold to Britain were always proved to be untrue in this period; in fact, total American iron exports in the period 1871 - 74 were exceedingly small when put alongside total imports. Lowthian Bell visited

Year	Imports (tons)	Exports
1871	1,185,543	5,251
1872	1,223,737	5,898
1873	608,661	14,428
1874	248,502	27,360

the country in 1875 and pronounced that "even with labour on anything like equal terms, it is a physical impossibility that iron can be made more cheaply in the United States than it can in England".(38) Even Bell

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(36) J.I.S.I., 1869, p. 23. Mr. Ford, Secretary of the British Legation at Washington, put U.S. wages 57% higher than those in Britain for foundries and machine shops, 48% for rolling mills and 47% for shipbuilding yards (iron).

(37) J.I.S.I., iii, 1872, p. 273.

(38) J.I.S.I., i, 1875, p. 141.

had to admit, though, that production of iron in the United States had "advanced at a rate unknown in their previous history", and in such items as rail iron it was becoming difficult for the British product to find a market behind the high level of protection operating in America. Over the next fifteen years, before Bell again visited the United States, even greater strides were taken by the American industry. Unlike the British industry, which had the whole world open to it and which pursued "a dozen ... channels through which to dispose of its production", the Americans "had virtually only their own market to sustain demand".(39)

In 1890, the year when the Iron and Steel Institute held its meeting in the United States and when United States production of pig iron surpassed that of Great Britain for the first time, the Institute's President seemed to take comfort from the fact that "while the United States (still) continues to find its markets in ever-growing demands from a civilised and prosperous people at home, we in England shall have in more distant fields, easily accessible to us from our insular position, a great market for our produce".(40) As almost an afterthought, Sir James Kitson concluded:

"We can look forward, each in our own sphere, to a growing commerce, to cope with which our united skill, aided by invention shared and knowledge freely given, shall confer lasting benefits on the world".

It fell to Sir Lowthian Bell to draw up a very lengthy report on the American industry, which appeared as a Special Volume of the Iron and Steel Institute in 1890. Characteristically, the Report contained a great deal of statistical information; Bell showed, for example, percentage figures of total make (in terms of pig iron) for both imports and exports of the United States and Britain in the period 1874 - 90. Britain's percentage of exports on make varied from 41.2 per cent (lowest) in 1876

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(39) Iron, 3/8/83.

(40) J.I.S.I., 1890, p. 11.

to 73.4 per cent (highest) in 1890. America's, by comparison, was extremely low, 7.7 per cent in 1874 and 3.3 per cent in 1890. An interesting point, upon which Bell did not comment, was that Britain's percentage of imports on make had nearly trebled between 1874 and 1890, the respective figures being 2.5 per cent and 6.7 per cent - the chief characteristic concerning the import figures for America was their wild fluctuation:

Year	Percentage
1874	14.9
1878	6.9
1879	34.5
1880	61.1
1883	19.9
1889	12.6
1890	9.8

Despite the rapid advance made in the American iron and steel industry and the very high level of protection, in hectic boom periods the United States had imported large quantities of iron and steel. Until now, in moments of dullness in their home market, the American producers had not sought to sustain growth in production by seeking further export orders. For example, in 1891 the make of pig iron in the United States was 923,000 tons less than in the previous year and yet Sir Lowthian Bell could write:

"I am not aware that any attempt was made, or contemplated, to continue the make of 1891 on the footing reached in the previous year by an extension of their foreign trade".(41)

If they had done this, argued Bell, they would have made a mockery of their determined efforts to gain even greater home protection. In any case, Bell did not think that the Americans were in any position to increase their exports on a wide front:

"With regard to an export trade in iron from the United States, I think it very improbable that, beginning with pig iron at 53/6 per

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(41) J.I.S.I., 1890, Special Volume, p. 21.

ton at Pittsburg, and adding 8/4 for carriage to a seaport, the older seats of the American iron trade can compete with Great Britain, except to countries close at hand, such as Canada and the northern portions of South America. If we are to meet American iron in Europe, Asia or Australia it will be that produced in the Southern States of the Union".  
(42)

Over the next five or six years further rapid changes took place in the United States, one result of which was that the American industry made a complete fallacy out of Bell's observations of 1890. Huge production totals were achieved in the first half of the 1890's - home competition was severe and led to extreme cost-conscious production methods - and when the home market proved inadequate the American industry turned to overseas markets.

From 1896 onwards, to a far greater extent than hitherto, the British iron and steel industry had to take the possibility and actuality of foreign competition firmly into reckoning. It was widely accepted, too, that the Black Country suffered "perhaps more than any other part of the kingdom" from what were described as "the operations of tariff-protected Continental (and American) iron and steel manufacturers, who from time to time seem to regard the Midlands as a legitimate dumping ground for their surplus products".(43) By tracing the fortunes of the Black Country iron trade in this period it is possible to show the extent to which foreign competition affected the industry.(44) Furthermore, the nature

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(42) J.I.S.I., 1890, Special Volume, p. 204.

(43) Colliery Guardian, 18/9/1903.

(44) By no means is it claimed that foreign competition was the sole factor influencing the state of the iron trade in the district. Other aspects of the industry - locational problems, communications, raw materials, plant and personnel - had their part to play; what is interesting is that the many shortcomings of the district made the Black Country industry less able to face foreign competition and survive.

of foreign competition becomes clear with regard to the iron and steel industry as a whole, and some previous views expressed on the subject are shown to be both misleading and a little suspect.

One indicator of the state of the South Staffordshire iron trade is a record of the prices at which pig iron and steel blooms and billets sold on the three main markets of the district - Birmingham, Dudley and Wolverhampton. In 1894, as indeed was the case throughout all the iron producing areas in the world, prices of all the listed products were extremely low and as far as the Black Country was concerned totally unremunerative. However, it was competition from nearby<sup>M</sup>idland areas, rather than foreign competition, which was adversely affecting the area's smelters, and north of England and South Wales competition keeping steel prices low. Within two years, however, prices began to rise on the Black Country exchanges; by September 1896 the weekly make of pig iron in the district - 6,000 tons from 23 furnaces in blast - was disposed of locally with very little going into stock. Prices were up on the January quotations, in some cases by as much as three shillings per ton; only the all-mine pig iron was showing no signs of improving in price mainly because of the disappearance of some of the former list houses who had principally consumed this class of iron. The steel producers in the district, especially Hickman's Spring Vales works, were said to be benefiting from the fact that north of England producers were fully engaged in meeting contracts for the United States and South Africa. In August 1896, Hickman was quoting 115/6 per ton for basic Bessemer bars and 125/- to 130/- for boiler plates.<sup>(45)</sup> His total production was said to be the largest that it had ever been "since the works were built". By the end of the year there was something of a steel shortage in the district.

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(45) Colliery Guardian, 7/8/96.



# Prices of various iron and steel products on the Black Country

Exchanges, 1894 - 1913.

Product (per ton)

Staffs. cinder

forge.

Part-mine.

All-mine (ord.)

" " (best)

Cold Blast.

Bessemer blooms  
& billets.

Siemens bars.  
" billets.

1894	1895	1896	1897	1898	1899	*	1900	**	1901	***	*	1902	**	1903
38/6	36/6	36/9	40/-	40/-	45/6	62/6	70/-	70/9	58/9	48/-	46/6	48/-	51/3	50/-
46/-	40/-	43/9	42/6	44/6	49/-	67/6	75/6	72/9	62/6	49/-	50/3	52/-	54/-	50/6
						75/-	77/6	77/9	73/9	55/-	55/-	57/6	62/6	62/6
60/-	52/-	57/6	55/-	57/6	68/-	80/-	90/-	94/-	92/6	82/6	77/6	77/6	78/9	81/3
-	-	93/9	90/-	90/-	92/-	102/6	120/-	124/-	-	-	100/6	100/-	-	97/6
-	-	86/9	95/-	95/-	102/6	118/9	150/-	-	122/6	-	102/6	97/6	101/3	96/3
		120/-												
		91/3	102/6	107/6	110/-	122/6	157/6	-	117/6	-	107/6	102/6	106/9	100/-

1904 1905 \*/\* 1906 // 1907 1908 1909 1910 1911 1912

Staffs. cinder

forge.

Part-mine.

All-mine (ord.)

" " (best)

Cold Blast

Bessemer blooms  
& billets.

Siemens billets.

47/6	43/6	55/-	57/6	46/9	56/9	53/-	46/-	47/-	50/-	51/6
53/9	45/-	55/9	61/9	48/3+	62/6	55/6	48/9	50/6	52/6	54/6
72/6	57/6	61/3	67/9	60/-	62/6	55/6	?	?	?	?
80/-	77/6	88/9	88/9	87/6	90/-	90/-	80/6	87/6	87/6	85/-
97/6	97/6	105/-	112/6	110/-	115/-	115/-	110/-	115/-	115/-	120/-
86/9	88/9	100/-	113/9	?	130/-	102/6	92/6	101/3	101/3	108/9
92/6	93/9	105/-	116/3	?	132/	107/6	95/-	103/9	103/9	111/3

The quotations, unless otherwise marked, are those of the winter quarter of each year.

Code: \* 28/7/99

\*\* 7/6/1900

\*\*\* 1/2/1901

\* 1/8/1901

\*\* 1/8/1902

\*/\* 1/12/1905

// 1/7/1906

As early as March 1896, South Staffordshire smelters were said to be threatened "with serious competition on the part of American producers". (46) The latter were said to be offering "pig iron in this country at lower prices than iron smelted by English firms". In fact, such reports were premature although pig iron from the Southern State of Alabama was beginning to come to Europe. Almost certainly, it was Axel Sahlin who first suggested that the large stocks of pig iron which had accumulated in the South should be marketed in Europe. American railroad companies carried the Birmingham, Alabama, pig iron to the coast at very low rates and it then crossed the Atlantic during the cotton season as ballast to ships bulging with light weight cotton; indeed, the great bulk of Southern pig (none was shipped from the North) was initially moved only in this limited period. Tonnage figures rose considerably in 1897 on

Imports of U.S. Pig Iron into the United Kingdom, 1897-1900

<u>Year</u>	<u>Tons</u>	<u>£</u>
1897	91,196	209,275
1898	76,356	180,614
1899	80,988	219,715
1900*	51,370	201,429

\* first ten months only

the previous year's total; by the end of July, 12,747 tons of pig iron had been sold to Austria, and by October 14,118 tons had gone to Belgian consumers (compared with a mere 569 tons in the same period of 1896). 5,000 tons of Alabama pig iron were also shipped to the Japanese ports of Kobe and Yoko. Viewed from the American side, the shipping of pig iron to Europe was a very risky business, justified only by the fact that it would have remained in stock if left in the United States. British merchant houses which handled the pig iron did so on very unfavourable terms to the Americans - a fact which led to the producers seeking new selling agents when the trade was established on a firmer footing. There was

(46) Colliery Guardian, 2/4/96.

(48) Colliery Guardian, 4/1/96.

also the possibility that the conservative-minded British consumers would not accept the pig iron at any price.(47) Sahlin's statement made later to an English audience that the pig iron would have been sold at any price (similar statements were, indeed, made by Schwab in 1900) could lead one immediately to think of economic dumping with very adverse results for the Black Country industry. However, when we look closely at the situation a different picture emerges. Throughout 1897, despite the presence of Alabama pig iron on the market, prices of most classes of pig were rising; at the end of 1896, it was thought "remarkable" by the trade press that only 23 of the 69 furnaces were actually in blast, whilst in February 1897 the pig iron sector of the iron trade was said to be "in a better position than it has occupied for a long time". The fact that Southern pig found a responsive market in the Black Country was largely because of this developing shortage of supplies for local consumers, together with the fact that it was of good quality. Some consumers were prepared to go so far as to say that the "Southern coke iron was ... the equal of the best brands of Scotch and English iron, and superior to makes of part-mine and cinder pigs". The U.S. Consul in Birmingham, commenting on the "healthy sales of American iron in English markets", in January 1899, also made the point that the Black Country consumed "large lots of American iron, chiefly forge grades", because its principal industry was "the manufacture of merchant bars and sheets".

(48) The Consul put the quantity of Southern pig coming into the district at "roughly 2,000 tons a month", although on one occasion a weekly sale of 6,000 tons had been recorded. This was at a time when the total weekly make of pig iron in the district was put at a little over 7,000 tons.

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(47) Southern pig met with a hostile reception in the Cleveland district when it made its first appearance; several hundred tons were imported by a Middlesbrough merchant in 1895, but they were still in his hands in May 1896. Colliery Guardian, 8/5/96.

(48) Colliery Guardian, 6/1/99.

It would be quite wrong in this period to say that American pig iron was "dumped" on the Black Country because at no time in 1897 or 1898 did it sell much below similar local brands. Jeremiah Head was speaking no more than the truth - no matter how much he frightened the district's smelters - when he told a South Staffordshire audience that pig iron could be sold in Birmingham, Alabama, for "24/- per ton on trucks".(49) Allowing for the very low freight rates across the Atlantic, and even including the "obstacles of high inland freight" once the iron left a British port for the Midlands, Southern pig iron was not sold at a loss when it slightly undercut quotations for the local makes.

By April 1898, the number of furnaces in blast in South Staffordshire had risen to 25, but their combined output was totally inadequate to meet the needs of local consumers. In the following month, the wharves of furnace proprietors were said to be completely bare of stock, whilst finished iron manufacturers were reported to be working from hand to mouth "even in cases where they have thousands of tons on order".(50) Prices of pig iron, described on the Wolverhampton market in August as "phenomenally high", continued to rise, in some cases by as much as 7/6 per ton in a single month. By November 1898, prices were said to be the highest for some years past, "both as regards forge and foundry sorts":

Staffs. cinder (forge) .....	50/- per ton
part-mine.....	50/6 to 55/- per ton
all-mine hot air .....	72/6 per ton
" " (ordinary) .....	56/- to 57/6 per ton
" " (best) .....	66/6 to 69/6 " "
Staffs. cinder (foundry) ...	45/- to 46/6 " "

"Were it not for the competition of American pig", remarked an observer in October, "pig iron makers might name their own prices".(51) Indeed,

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(49) Proc. S. Staffs., 1897 - 98, p. 121.

(50) Colliery Guardian, 26/8/98.

(51) Colliery Guardian, 14/10/98.

without Southern pig iron coming into the district the finished iron trade of the Black Country would have broken down in the winter of 1898-99. Early in May 1899, supplies of Southern pig to the Black Country did dry up; it was reported on the Birmingham Exchange that American producers had notified their United Kingdom agents that they would be unable to complete contracts for pig iron. As a result consumers who had been waiting for the pig iron had to swell the ranks of those already seeking after local supplies. The total weekly make of just over 7,000 tons of pig iron was supplemented by a further 7,000 tons from other Midland areas but, without American pig iron on the market, prices of all classes continued to rise. The lowest priced pig iron made in South Staffordshire - cinder pig for forge purposes - was selling at 50/- to 52/6 per ton, compared with 36/- to 37/- in January 1895. Rumours were current in the district that some local pig was actually being purchased by American agents for shipment to the United States, whilst sales of cold blast pig iron at 92/- to 95/- per ton were definitely being made to Belgian and German consumers. Prices reached their peak in June 1900:

Staffs. cinder forge .....	70/-	per ton
part-mine .....	75/-	" "
all-mine (ordinary) .....	77/6	" "
" " (best) .....	90/-	" "
cold blast .....	120/-	" "

For about twelve months, the only American iron to be offered by agents in the Black Country was at prices which did not attract many local buyers. In August 1899, the price was 75/- per ton, whilst in May 1900 it was being offered "for delivery in the autumn when the cotton shipping season arrives" at 85/- per ton delivered Birmingham.(52) It was recognised locally that the abnormally high prices of local brands of pig iron was likely to attract American pig; with American production then running at the rate of 15 million tons annually, it was "quite expected that a good

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(52) Colliery Guardian, 18/8/99 and 11/5/1900.

deal of surplus production would be offered in the Midland iron markets during the present summer". Indeed, the summer of 1900 was a very confusing one for the Black Country industry; prices fell sharply in the United States (a further encouragement for U.S. producers to turn to European markets) and a sharp drop in both Cleveland and Scotch warrants caused something of a slump on the Birmingham Exchange. American competition was blamed for this sudden reversal but comparatively very little foreign iron was actually sold in the district. The quality of the iron offered for sale was very low and there were frequent delays in delivery; besides, the price was "not materially" in favour of the American iron. In September, the amount of American pig iron for sale was even lower; there was considerable uncertainty as to freight charges "in consequence of the cotton situation, and by the increasing disinclination of shipowners to allow pig iron to be carried free as ballast".(53) Whether the prospects of American competition had been the real cause or not, the artificially high price levels had come to an end; there were no sudden falls - the trade spoke of "abatements" - but stocks of pig iron began to grow as sales became less frequent. "The present depression" was a phrase used to describe the situation in the iron trade and instead of there being talk of blowing in more furnaces five out of the mid-summer total of 23 had been blown out by December, including the Willenhall furnaces of the Patent Shaft and Axletree Company.

The second product in the Black Country to face American competition was steel; in this case the competition came from Northern steelworks situated in Pennsylvania. Once again, however, it would be quite wrong to imagine the Americans "dumping" steel in the Midland markets with disastrous results for the local producers. In 1896, the few major steelworks in the

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(53) Colliery Guardian, 21/9/1900.

Black Country had full order books and there was a mounting shortage of billets and blooms and tin-plate bars. Bessemer steel blooms and billets were selling at 85/- to 87/6 per ton, with slightly more for Siemens billets. Local re-rollers of imported steel, i.e. from the north of England and South Wales, were thinking of overcoming the shortage of supplies by establishing a new steelworks in the district for the production of steel blooms and billets of Bessemer and Siemens qualities.(54)

Early in January 1897, some considerable excitement was caused on the Birmingham Exchange with the announcement that there was a shipment of steel billets on its way from Philadelphia to Britain at "the extremely low price of 85/- a ton delivered in the Midlands". Later in the same month, a cabled news item from the "Harrow" was received in the district announcing the ship's departure from Philadelphia; on board were 2,000 tons of steel billets (72/11 f.o.b.), 1500 tons of which was for the Birmingham market. Local agents then announced that the selling price in Birmingham would be 85/- per ton, or fully 10/- under the then English minimum. In fact, the steel was largely used for the rolling of galvanized sheets. A leader writer on the Colliery Guardian caused further disquiet in the district with the statement that negotiations were in progress in Philadelphia for the sale of 20,000 tons of billets to European buyers "on the basis of 75/- per ton delivered in this country".(55) Even at this price the Americans were said to have a fair margin of profit "after cost of handling and transport, and middlemen's charges are deducted".(56)

Inevitably, exaggerated stories of large sales at very low prices were

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(54) Colliery Guardian, 30/10/96.

(55) Colliery Guardian, 29/1/97.

(56) Additional evidence that the Americans were not "dumping" their material is shown by the fact that the same steelworks was selling steel in the United States at less than £3 per ton.

recorded in the Black Country; very little American steel was sold in the district for as little as 80/- per ton and the one works alone reported to have purchased 9,000 tons was not identified.(57). Gradually, the excessive claims made about American steel competition died down and the saner minds in the district recognised that it would not last any longer than did the two factors which accounted for it - namely, "almost unprecedentedly bad trade in the States, and high prices here". Indirectly, the presence of American steel in the Black Country also brought about renewed competition from Scottish and north of England producers who were thought to have found it advisable to meet the needs of the Midland district "rather than give the desired opportunity to the American manufacturers of obtaining a foothold in the English market".(58) What is certain is that, in 1897, American steel in the Black Country helped to overcome a shortage in supplies to the finishing trades; because this was the case the former product did not greatly affect the price levels prevailing in the district. At most, steel producers decided to drop the price of billets about 2/6 per ton "in order to keep the American product out".(59) The district's large steel producers, and especially the Spring Vale and Round Oak works, were said in March 1898 to be "as busy as their owners can wish them to be".

Slightly more unwrought steel was imported into the United Kingdom from

Imports of U.S. Unwrought Steel into the United Kingdom,  
1897-1900

<u>Year</u>	<u>Tons</u>	<u>£</u>
1897	25,297	128,892
1898	29,374	158,689
1899	59,375	288,706
1900*	96,011	636,000

\* first ten months only

(58) Colliery Guardian, 19/2/97.

(59) Colliery Guardian, 7/5/97.

(57) ENGINEER, 12/3/97.



the United States in 1898 than in the previous year, and a great deal more in 1899, yet throughout the period prices continued to rise.(60) Hickman's quotations rose repeatedly in these months, sometimes by as much as 5/- a ton a week or so after the last Quarter Day lists. In October 1898, his list prices showed increases of 5/- to 15/- per ton on plates, 12/6 to 17/6 on angles and 10/- to 15/- on tees and bars over those of October 1897. The Black Country steelmakers in 1899 were obviously in an "enviable situation":

"The dearth of steel is becoming as conspicuous in this district as the marked scarcity of pig iron. The shipbuilding yards in the northern steelmaking centres are consuming all the local output and this activity reacts favourably on Staffordshire, causing orders which used to go north to be placed with makers in this district".(61)

In January 1900, Bessemer blooms and billets were selling at 145/- to 155/-, whilst best Siemens fetched an additional 2/6 per ton; these prices showed increases of over 60/- per ton since the same month in 1896.

Sales of American steel to the United Kingdom in the first four months of 1900 had declined to insignificant totals; by June, however, following

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(60) Although the American home market was satisfactory in 1898-99, it would be wrong to give the impression that American producers were not competing with British and European makers. In April 1898, the Government of Victoria accepted the tender of the Pennsylvania and Maryland Steel Company to supply 14,000 tons of steel rails and fish-plates for £75,471. Two other tenders, both English and both rejected, were for £79,244 and £81,256. At the same time, it was stated that the authorities of the E. China and Siberian Railway of St. Petersburg had placed a contract with an American firm for 32,000 tons of steel rails and 4,000 tons of accessories to be delivered at Vladivostok. (Colliery Guardian, 22/4/98)

(61) Colliery Guardian, 3/3/99.

closely on the collapse of the American home market in April, exports had jumped:

Imports of U.S. Unwrought Steel into the United Kingdom,  
January - October 1900.

<u>Months.</u>	<u>Tons.</u>	<u>£</u>
January	409	3,988
February	369	5,190
March	585	4,991
April	2,632	18,955
May	2,190	17,684
June	14,988	109,034
July	10,200	67,108
August	11,883	84,663
September	21,538	142,796
October	31,217	181,591

A month later, the high prices for both semi- and finished-steel products in the Black Country began to ease; gas strip fell to £9 - 10s. per ton in that month (5/- less was being accepted for orders of 100 tons and over) because of competition from American firms. In September, with American steel billets reported on sale at £1 per ton below English quotations, consumers were able to persuade local producers to reduce prices. The Carnegie Steel Company had chartered the British steamship "Sir Richard Grenville", of Plymouth, to sail regularly from Philadelphia to Manchester and Newport(South Wales) with cargoes of steel billets from their mills at Pittsburgh. It was reported in the trade press that the steel was for making tin-plates and structural steel and beams:

"Upon delivery of her cargo English manufacturers will for the first time use American steel in making tin-plates at Swansea and elsewhere".(62)

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(62) One result of imported American and German steel was to give coastal sites a further advantage over the inland areas. Frequent references were made in the trade press to the increasingly severe competition which inland galvanized sheet makers could expect from their rivals in South Wales. (e.g. Colliery Guardian, 14/9/1900). K. Warren, op cit, pp. 92 - 95, writes: "the arrival of foreign semi-finished steel was yet another factor pulling Midland (sheet) firms coastwards or for those unable to move rendering them less competitive".

The end of 1900, in one sense, brought to a conclusion the first phase of intense foreign competition in both pig iron and steel. It had lasted for about three years - if intermittently - , had been greeted with exaggerated fears and had been largely American in origin. In this period, the United Kingdom became an importer of pig iron on a fairly large scale for the first time, together with semi-finished products like steel billets for re-rolling into sheets and bars. As far as the Black Country itself was concerned - when all things American became of great interest and to imitate them was the panacea for all the district's ills - imports of American pig iron and steel was, on balance, beneficial to the area. Neither smelters nor steelmakers suffered from the competition to any appreciable extent, and what prosperity many of the South Staffordshire ironmasters achieved in these years was largely due to the fact that they were able to roll down imported steel billets into bars and sheets. North of England and Welsh districts were too busy for much of the time with the steel rail trade to be able to supply the Midlands with "semis"; the continued prosperity of the wheel and axle manufacturers and those engaged in the subsidiary branches of the comparatively new cycle trade was in no small way due to imported American steel.

The second phase in foreign competition began with the reappearance of Belgian and German iron and steel in the Midland markets. Although American competition remained fierce in both foreign and colonial markets, notably in the whole range of finished iron and steel products, it was the severe competition from the Continent in the bar iron trade which greatly disturbed South Staffordshire producers. Most brands of pig iron fell steadily, not because of the appearance of any foreign pig iron, but because of imported Belgian and German bar iron. By February 1901, common bars had fallen by more than £4 per ton from their peak of the previous Summer; two months later, formidable Belgian competition - "at prices absolutely ruinous to English producers" - in both bar iron and

iron and steel wire brought about further reductions. Belgian No. 2 bars

Pig Iron Prices (Jan., Feb., & Aug. 1901)

<u>Brand</u>	<u>January</u>	<u>February</u>	<u>August</u>
cinder forge	57/6-60/-	47/- - 49/-	46/- - 47/-
part-mine	60/- 65/-	48/- - 50/6	49/- - 52/6
all-mine (best)	90/- 95/-	80/- - 85/-	75/- - 80/6
" " (ord.)	72/6 75/-	52/6 - 60/-	52/6 - 60/-

were quoted f.o.b. Antwerp and Rotterdam at 102/6 a ton, and ex-steamer in the Thames at 106/- as compared with 145/- for Staffordshire bars and 135/- to 140/- for Lancashire bars at ports.(63) Even the list houses, whose brands were generally indented by foreign customers to merchants, were only working about one-third time, despite great reductions in their quoted prices:

Prices of Marked Bars (1900 & 1901)

1900	1 January	£11 per ton
	1 February	£11/10 per ton
	1 November	£10/10 " "
1901	1 January	£9/10 per ton
	1 May	£8/10 " "

Once they had worked through their orders arranged before the January Quarterly Meeting, South Staffordshire smelters were faced with the choice of either building up their stocks of pig iron or blowing out one of their furnaces. Few smelters welcomed any reduction in make because it could easily mean the addition of 1/6 to 2/- per ton to the cost of the remaining production; however, with prices having fallen so low each ton of pig iron made could mean a loss of 2/6 to 3/-. By June 1901, only 16 furnaces were in blast. The bar iron department showed no signs of improving throughout the summer and autumn, whilst in November Staffordshire chain makers were being offered good quality Belgian bar iron for only 122/6 a ton delivered at Midland stations. However, agents from the Belgian firms were frequently advised to raise prices, a fact which

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(63) Colliery Guardian, 12/4/1901.

irritated Midland consumers, who then tended to give their custom once more to local suppliers. In fact, some observers of the Black Country iron trade felt that in general it was not in too bad a state; only in this one sector was there severe competition. Against this view, though, is the fact that accountants for the Midland Wages Board showed that over the previous twelve months the average selling price in the Staffordshire iron trade had dropped by as much as 61/8 per ton.

In the first half of 1901, a certain amount of American raw and finished steel was coming into the Midlands, but this dried up temporarily as a result of serious labour troubles in the American iron and steel industry. By the time the dispute was settled, heavy home demand for steel rails and constructional steel was absorbing all the American production. In fact, for some time to come, the South Staffordshire industry was to feel the effects of American competition only in the finished steel markets of both colonial and neutral countries. Fortunately for the finishing trades in South Staffordshire, a great deal of German steel was coming into the district in the closing months of 1901; with very few steel blooms and billets coming into the district from South Wales (Welsh steelmakers were busy with tin-plate orders and were not interested in supplying Midland consumers), local sheet makers and producers of hoops and strips would have found the going very tough. Indeed, it was observed in November that several local works would have had to close "but for foreign importation".(64) In addition to overcoming a shortage of semi-finished steel in South Staffordshire, German steel imports also had the effect of preventing any advance in price for Welsh and Scottish billets and tin-plate bars; the latter steel was infrequently offered in the district at 105/- per ton, whilst German steel was quoted at 95/-. Local opinion

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(64) Colliery Guardian, 22/11/1901.

felt that the Germans must be losing money at this price, and in fact only a small amount of German steel actually materialised in the Black Country at anything like 7/6 to 10/- below home prices.

The beginning of 1902 brought very little change to the scene. Virtually no American iron and steel was coming into the United Kingdom and it was a rumour that American agents were actually buying in British markets that caused prices to rise slightly. It was felt, however, that Staffordshire firms were "too far from the coast to benefit much by the Transatlantic requirements". The winter Quarterly Meeting of the Black Country iron trade, held in Birmingham in January 1902, was largely taken up with the unsuccessful attempt of the Unmarked Bar Makers' Association to withstand Belgian competition in bar iron. The basis price of £6/15 was fixed by the Association, but members were prepared to sell good merchant bars at £6/10 to £6/12/6 "delivered by boat at works in the district". Belgian bar iron was in evidence at £5/17/6 delivered. German steel was quoted by agents at prices a little higher than those quoted late in 1901; namely, steel-plating bars at 97/6 to 100/- and billets at 87/6 to 92/6. February saw a further rise of 8/- per ton in quoted German prices, which brought them very much level with home prices. German gas strip and steel tube strip disappeared completely. So desperate were Black Country consumers to obtain German blooms and billets in March that they were paying above the contract price to obtain delivery; there was little or no Welsh or north of England steel on the market. Birmingham merchants, with orders to fulfill from India and the East Indies, were ordering steel sheets at £6/5 per ton f.o.b. Hamburg and Antwerp; even if Black Country producers had been able to supply the local merchants their prices would have been £7/15 f.o.b. the Thames or Mersey. By the time the summer Quarterly Meeting was held, the price of home-produced steel blooms and billets had risen to between £5 and £5/2 per ton for

Bessemer quality and a further 5/- per ton for Siemens quality; both the Germans and Belgians were selling in the market but not without a certain amount of difficulty. There were frequent complaints made by the consumers of Black Country sheets that the product made from imported metal did not match the quality of sheets made from Welsh steel. Furthermore, the Belgians were not particularly anxious to meet any special requirements of the Black Country producers, or to guarantee delivery dates. The most that could be said for both Belgian and German imports was that they kept the market disturbed and, marginally, kept home prices a little lower than they might otherwise have been. In the closing months of 1902, a number of large contracts were placed by Black Country producers for German billets and tin-plate bars, especially when one German house came on the scene offering 20,000 tons of steel billets "of reliable quality", together with guaranteed prompt delivery. However, it was again felt by local ironmasters that the Germans were selling at a loss<sup>(65)</sup> but that if they did not take advantage of the foreign steel many of their number would be compelled to close their works or to put them on short time. Furthermore, only by using cheap Continental semi-finished steel were South Staffordshire makers able to withstand the growing Belgian and German competition in the Mediterranean markets and the Far East; as it was there appeared to be "a continual shrinkage" in South Staffordshire exports of black and galvanised sheets, tin-plates and fencing wire.<sup>(66)</sup>

For the first three months of 1903, a great deal of foreign steel came into the Midlands; just as harmful to the Black Country trade (and elsewhere) was a growth in the amount of German iron and steel coming into London and Hull for reshipment to Australia, South Africa and Far Eastern markets by English merchants. A temporary respite occurred in April.

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(65) Briefly, German billets and steel ingots were offered at 86/- a ton delivered; prices then went up again to between 90/- and 92/6 per ton.

(66) Colliery Guardian, 28/11/1902.

German firms, hoping to gain higher prices in their home market and in Russia, sought to close the unprofitable contracts entered into with Black Country consumers. Several large firms in the district were actually offered 7/6 a ton by the Germans to cancel their orders. Within six weeks, however, both the German and Belgian agents were back in Birmingham and Wolverhampton seeking orders. Makers of Staffordshire common bar were forced into greater price concessions because of severe Belgian competition, whilst German wire and wire rods came into the district at 10/- to 15/- a ton below local quotations.(67) Perhaps a little late in the day, was the full realisation by the Black Country iron trade that the Continentals "had come to stay". There was no doubt, too, in the minds of the South Staffordshire ironmasters that, whether they were selling at below cost or not, the Belgians and Germans could "at least compete with South Wales and the north of England firms in respect of deliveries to the Midlands". Belgian basic steel bars were quoted £5 a ton f.o.b. Antwerp, and another 15/- a ton saw them delivered to Midland stations as compared with £6 to £6/10 for local makes; German steel bars were quoted 90/- to 92/6 and billets 87/6 to 88/6 delivered.(68)

This second phase in foreign competition, which had commenced with the departure of American iron and steel from Midland markets, really came to an end in September 1903. If the first phase had been primarily American in origin, the second had been almost exclusively Continental. No pig iron was included in the list of imports, but Black Country smelters suffered, nevertheless, from the severe Belgian (and to a lesser extent German) competition in the common bar department. The Black Country iron trade was "stationary" for much of 1902 and 1903, with only speciality

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(67) Colliery Guardian, 10/7/1903.

(68) Colliery Guardian, 5/6/1903.



iron and high-class brands giving producers any profit at all. Facing "disproportionately high" production costs with regard to raw materials, fuel and labour, South Staffordshire mills and forges frequently stood idle whilst agents from Belgian and German houses left the district "with their order books well filled". However, it must be stressed that with regard to the imports of steel blooms and billets the Black Country consumers were never more happy than when they were coming thick and fast; the British producers who lost out were the makers of semi-finished steel in South Wales and the north of England. This explains why the three large producers of steel in the district - Round Oak, Spring Vale and Patent Shaft - did not face any real difficulty in this period. These plants did not produce steel for the local finishing trades; Hickman's steelworks was fully employed on heavy sections, whilst Patent Shaft had concentrated on bridgeworks and locomotive requirements.

The third phase in foreign competition began in the late autumn of 1903, with the reappearance of American steel blooms and billets in competition with Continental imports. As late as the end of September, it was openly expressed in the Midlands that the American Steel Trust would not be able to undersell English firms there without incurring considerable losses; in any case it was also reported that the Steel Trust was selling at home practically all the steel that it could produce at between £5/4 and £5/9 a ton, i.e. between 11/6 and 16/6 per ton more than they could hope to obtain in England. In fact, such Black Country opinion was not based on fact; steel could be produced in the United States for 48/- a ton and even if 16/- were added to this figure for transit costs any steel sold over 64/- in England would show a profit. At the end of October, contracts for something like 100,000 tons of steel billets and tin-plate bars had been signed by American agents in South Wales on behalf of the American Steel Trust. Tin-plate bars were offered at 80/- a ton delivered at Newport, and about 87/6 delivered in the Midlands. Terms were strictly

"net cash on delivery", but they compared favourably with the 90/- asked for German steel and 92/6 for English or Welsh bars. United Kingdom markets, and especially South Wales and the Black Country, were now being fought over by the American Steel Trust on the one hand and the German steel syndicates on the other. Something like 18,000 tons of German billets and tin-plate bars were coming into the country via the Bristol Channel ports per month, and "probably double the quantity" through eastern ports.(69) The American Steel Trust took the unprecedented step of inviting offers from customers, rather than send quotations through American agents, and it was alleged on the Birmingham Exchange that "Americans bars intended for the Midlands (had) been ... offered, c.i.f., at Newport at £3/17/6". In face of such fierce competition in the South Wales market, the Germans and Belgians decided to concentrate their efforts on the Midland markets. German sheet bars, which were quoted in Germany at £6 per ton, were on sale in South Staffordshire, delivered to stations nearest to consumers' works, at 85/-; German steel rods were also on sale in South Staffordshire at between 2/6 and 5/6 below the price of English rods. The Americans still undersold at even these prices, and in steel strip their quotations were at fully 20/- below those of Welsh and Staffordshire producers. At the height of the competition, the Carnegie Steel Company secured a 20 per cent concession from the railway companies carrying their steel to the coast for transatlantic shipment. In addition to this "stern" competition in their own local market, South Staffordshire producers found themselves ousted by foreign competitors in London and other ports.

What were the effects of this "war of the giants" on the Black Country iron trade? In the first place, manufacturers of finished steel in Birmingham and South Staffordshire, took advantage of the cheap supplies

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(69) Colliery Guardian, 2/10/1903.

to increase the quantity of bars, sheets, plates and strip being rolled in their works (indeed, the cheap steel was essential if Black Country firms were to sell abroad). However, because they were re-rolling steel, such firms were no longer in the market for bar iron, with the result that whilst each week there was an increased quantity of steel being re-rolled there was a corresponding displacement of finished iron. Local demand for pig iron was not sustained and smelters found their rates to be the lowest for something like four or five years; indeed, prices were to go even lower before anything like a revival was to be felt.<sup>(70)</sup> With the number of list houses down in January 1904 to about half of what they were ten years previously, there was little demand for Staffordshire hot air and cold blast pig irons. Most of the South Staffordshire firms tended to confine their attention to producing specialities and sectional iron for engineering and naval purposes. Perhaps because of the harm being done to this very important section of the local iron trade, a certain amount of attention and publicity was given to the possible repercussions of allowing so much imported steel to come into the district. An example was taken with regard to steel rods imported from Germany:

"if 1,000 tons of steel rods are produced in Germany and sold in this district, it will mean a loss of production here not only of the rods themselves but also a loss of the labour which would be required to produce the raw material needed for the manufacture of the rods. It requires about 3,000 tons of ore and about 1500 tons of coal (in the form of coke) to convert the ore into pig iron and about 450 tons of coal to turn the pig iron into billets, besides about 550 tons of coal to transform the billets into rods, so that

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(70) From the list of pig iron prices, it is possible to see that pig iron reached its trough in the late winter of 1905.

1,000 tons of rods obtained from abroad instead of from the Midlands means a loss of labour in producing 5,500 tons of raw material, to say nothing of the labour needed in producing the rods themselves".(71)

Of some considerable interest, too, was the fact that at the height of foreign competition, renewed interest was shown in the plans to build a new large steelworks in the district to supply the re-rollers with blooms and billets. On this occasion, the lead was taken by the Wolverhampton Corrugated Iron Company - a large consumer of German steel - with a public promise that its custom would go to any such firm. In fact, in January 1904, it was reported in the district that "a well-known Midland firm has decided to make its own billets instead of purchasing them from the Americans and Germans and for this purpose have reconstructed their furnaces and laid-down a modern steel-making plant. Last year the firm used 50,000 tons of German billets".(72)

For a few months in 1904, supplies of foreign steel drastically fell off; there was nothing for local consumers from either America or the Continent and when supplies were renewed in April quoted prices had risen by 5/- per ton. This additional 5/-, making imported steel 90/- a ton, made English supplies at between 85/- and 87/6 for Bessemer quality much more attractive. In May, when again both German and American steel was virtually withdrawn from the market, home-produced supplies not only rose in price but were also inadequate to meet the requirements of Black Country consumers. For this section of the trade, it was fortunate that towards the middle of June the German Steel Syndicate reappeared with quotations reduced by as much as 5/- per ton. The Syndicate was reported to be anxious to find an outlet for "a very large surplus production"; accordingly,

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(71) Colliery Guardian, 9/10/1903.

(72) Colliery Guardian, 22/1/1904.

steel billets were offered at 87/6 a ton delivered Midland stations. At the summer Quarterly Meeting of the iron trade held in Birmingham in August there were plentiful supplies of blooms and billets. Bessemer billets were quoted at 85/- to 90/- a ton, or about 2/6 less than three months ago and 5/- below the price of twelve months ago. Comment made by representatives of the iron trade covering the whole country showed clearly that the Black Country was not the only district experiencing a renewed burst of foreign competition: the "depression" was "severe", with strong competition both in home markets and abroad. Pessimists on the Birmingham Exchange suggested that the closing of the greater part of the Midland iron and steel sheet mills was "inevitable". The American Steel Trust was also in the market, "underselling Welsh, German and Staffordshire makers alike"(73); billets and sheet bars could be delivered to Birmingham for 84/- a ton in quantities as small as 500 tons at a time with a guaranteed delivery within a month. This price compared favourably with United Kingdom steel quoted 87/- to 90/- for Bessemer quality, and 2/6 extra for Siemens, less 2 1/4% discount for prompt payment. With the exception of the four local steelworks, foreign competition was hitting the district hard; even with steel "semis" at such low prices, the local mills could find no profit because of the small amount of work which they acquired. Many mills and forges were on short time, perhaps working for only three days of the week; a good proportion of their expenses and dead charges remained the same as if they had full order books. German billets went as low as 77/- a ton in an attempt to find buyers, but the trouble was that the Black Country producers could not sell the finished article at a profit.(74) Wire rods could be obtained at very low prices from the

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(73) Colliery Guardian, 15/7/1904.

(74) South Wales galvanised sheet makers, for example, were able to obtain large consignments of American steel "at exceptionally low prices". The Birmingham correspondent of the Colliery Guardian commented: "the competition of the galvanised sheet makers situated on the coast with the inland firms is evidently destined to become increasingly severe", 5/8/1904.

Continent, whilst Belgian rolled steel girders could be obtained for 95/- a ton, compared with over 117/- for the home product. Some success was achieved by the Midland axle trade in face of strong American competition, largely through the introduction of improvements in axle construction. The very important tube trade also came under severe German and American attack, and several descriptions of tubes were sold at well below local prices.

As to which side came out on top in the struggle for supremacy of the Black Country market - the Americans or the Continental producers - is a matter for conjecture. For sheer bulk in contracts, the Americans probably had the edge, but their slightly lower quotations hid the fact

<u>Product (5/8/1904)</u>	<u>U.S.</u>	<u>Continent</u>	<u>Welsh</u>
billets (offered Birmingham del.)	81/9+	82/6+	85/-
steel bars	84/-+	85/-	87/6 - 90/-

that these were normally only for large contracts at prompt cash settlement. As a result, the Belgian agents more often than not obtained renewal of contracts with Black Country consumers, whereas the Americans failed to do so. The average Black Country consumer was small; he did not want to make large purchases and in difficult times he had little available cash for prompt settlement. It is quite possible that if the South Wales district had been regularly able to meet the full requirements of Black Country consumers, at competitive prices, foreign producers would have found things very tough indeed. To improve their marketing of steel in the main English markets, the German Steel Trust, in October 1904, decided to create a single selling agency - the German Steel Union Agency Ltd.. A number of London English houses participated in the scheme, but those who did not quickly unloaded their stocks of German steel on the market.

Indeed, in that month German steelmakers were reported to have "obtained

virtual supremacy in the Midland markets for crude steel and their finished steel goods, such as plates, bars and engineering sections".(75) Together with a few Belgian houses, the Germans were quoting billets at 72/6 to 75/- at English ports and sheet bars at 75/- to 76/-.

Even in 1904, it would be wrong to suggest that the Welsh and English manufacturers were not making strenuous efforts to retain their home trade. Two of the largest consumers in the combined South Wales/South Staffordshire market, Guest, Keen and Company and Lysaght, had become two of the largest makers of the raw materials; as a result the market for foreign "semis" was considerably contracted. A large programme of plant improvement was undertaken by English and Welsh steelmakers - details of the Black Country itself are given in a different section - and new processes introduced in an effort to cheapen production costs and so make them more able to resist foreign producers. It was generally recognised by now that the Germans could not produce steel much below works in either South Wales or the Black Country, but they were able to sell cheaply abroad because of their government's rebate schemes, coupled with the fact that they obtained profitable prices at home. English producers were, on the whole, prepared to accept that they could do little about this(76), but they were angry at the way British railway companies and shipowners favoured German and Belgian firms by offering concessions on the delivery of goods to the Midlands. Some American firms actually found it worth their while to send their steel to English ports and to the Midlands via Antwerp.

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(75) Colliery Guardian, 14/10/1904.

(76) One or two of the larger English firms did try to carry the fight to the German home market. Guest, Keen and Company, for example, matched the dumping policy of German screw-making firms (at one time the Germans were selling screws in the Midlands at 84% off the list prices) by offering their screws in the German home market at 80% off list. This proved a sufficient inducement for the Germans greatly to reduce their discounts.

This third phase of intensive foreign competition began to draw to a close in the last few months of the year. Even before the Westphalian Coal Strike early in 1905, German agents had advanced the price of billets and bars by 2/6 per ton in the Birmingham market and they were not disposed to accept orders of less than 500 to 1,000 tons. The German industry, in fact, was finding more lucrative markets in Russia and, although agents reappeared early in May 1905, a further 7/6 per ton was being asked. Coupled with the fact that American competition had also "been got out of the way", English billets were commanding much higher prices - 90/- for Bessemer quality and 92/6 to 95/- for Siemens. By the middle of June, imported steel was actually dearer than the home product, and there was something of a shortage in supplies for the Black Country. A structural weakness in the local industry was only too obvious when the re-rolling sections could not obtain their raw materials; the small sheet mill could not hope to compete with the Belgian producers, "who not only produce their own raw material, and work it up into the finished article, but have the advantage of lower shipping and railway rates as compared with the Midlands".(77) It was at such times that discussions took place as to the possibility of the various Midland firms combining to set up a new semi-finished steelworks; however, as in the past, in 1905-6 it was still regarded as too risky a venture, especially as a very large outlay would be required to do anything on a scale sufficient to cope effectively with existing Welsh and future Continental competition. Much, indeed, would depend on just how long steel prices continued to rise.

From 1906 until the outbreak of war in 1914, the Black Country continued to experience bursts of intense foreign competition; unlike the earlier phases they were no longer unexpected, especially when market conditions

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(77) Colliery Guardian, 23/3/1906.



contracted in either the United States or Germany. Interspersed with these periods of low prices were short-lived boom spells which arose largely out of expansion in the German and United States markets. It was, indeed, the case that the British home market was no longer capable of instigating boom conditions beyond very localised cases. A revival in the fortunes of the Black Country iron trade took place towards the end of 1906 and lasted for about eighteen months, reaching a peak in 1907. It was generally recognised even at the time that this revival was due to increased demand for iron and steel in both Germany and the United States; foreign steel did not entirely disappear but it was never available for immediate delivery in the Black Country and appeared chiefly to test the strength of the market. Consumers of steel billets had to wait up to three months for delivery and pay between £6 and £6/2/6 per ton. The pig iron department matched the prosperity of the other sections of the iron trade in 1907, despite the occasional spell of uncertainty created by weaknesses in the Scotch warrant market. Almost no foreign pig iron had appeared in South Staffordshire since the Alabama pig scare but what was interesting about the 1907 boom was the scarcity of Northants pig iron in the district due to the export of the latter product in large quantities to German and Belgian consumers. Contracts for 6,000 and 10,000 orders were signed by Northampton smelters in 1907 and again in 1909 - they could get better prices by shipping their pig iron through King's Lynn to Germany than they could obtain in South Staffordshire.(78)

When 1908 opened trade was already again declining and it remained in a state of depression for nearly two years. For much of this period, it was the Belgian industry which gave the Black Country the most bother,

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(78) There was, in fact, a shorter railway distance between the furnaces and King's Lynn compared with the distance to South Staffordshire and the price paid by the Germans f.o.b. King's Lynn was higher than the price to be obtained in the latter district. The German industry liked the the Northants iron because of its phosphoric nature and suitability for their basic Bessemer steelworks.

although both German and French steel (as well as American) added to its difficulties. In October 1907, steelworks in the Charleroi district had sent circulars directly to Black Country consumers offering finished steel at what were undoubtedly "dumping prices":

<u>Product</u>	<u>Price per ton</u>	
Steel merchant bars	125/-	
tees and nail rods	130/-	
joists	133/6	
channels	137/6	
hoops	160/-	(79)

These prices were between 15/- and £1 per ton below South Staffordshire quotations and in the case of nail rods a full £2. Foreign strip was also coming into the district, and Belgian common bars could be obtained for 15/- per ton below South Staffordshire prices. However, this latter material had less of an impact than it might have caused because delivery could not be made in under two months. Steel prices collapsed in the Black Country with the appearance in force of the Stahlwrks-Verband at the end of November; English prices had been £6/7/6 but the Germans offered billets at 95/- a ton and the English quotations slumped to 105/-. By the end of January 1908, all the fight seemed to have gone out of English steelworks and "supplies could be had almost for the asking".(80) The situation was the same in South Wales, with combined American-German imports of steel "semis" coming in at 6 - 7,000 tons a week. Special port facilities had been provided at Newport for the importation of steel bars and in the first four months of 1908 56,214 tons of steel bars came in (compared with 39,425 tons in the same four months of 1907). The Germans seemed to have taken over from the Belgians as the main source of danger to the Black Country iron trade by the middle of 1908. The wire trade was brought almost to a standstill in June, whilst in the following

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(79) Colliery Guardian, 25/10/1907.

(80) Colliery Guardian, 30/1/1908.

month German billets for delivery in the Midlands were quoted at 84/- to 85/-. A small amount of Belgian steel was offered for as little as 80/- to 81/-, whilst German strip was also available at £6 per ton delivered as compared with the £6/10 quoted by local producers. In fact, Stewarts and Lloyds bought 16,000 tons of foreign steel strip at one go in June 1909 in an attempt to force down the price being charged by the Gas Tube Strip Iron Association; the move was successful in that the Association lowered its price level, but it was resented by large sections of the trade. For some time, home producers in various branches of the industry were reported to have been sacrificing some of the profits made during the boom period of 1906 and 1907 in order to hold their own against foreign competitors:

"Certainly the day has gone by when English makers were content to allow Continental makers to undersell them by 10/-, or sometimes even by £1, with hardly a murmur. Every inch of the competitive ground appears nowadays to be hotly disputed".(81)

Another sign of resistance by the local Black Country trade was the decision of Sir Alfred Hickman, Ltd. to take on the foreign producers in their hitherto most successful department - half product bars and billets. The Bilston firm undertook a programme of expansion reportedly costing £100,000; the main development was the construction of an electrically-driven merchant mill for the production of small sizes of steel bars. Sir Alfred Hickman was thus individually creating a local supply of semi-steel for the sheet-making industry, something that the sheet-makers themselves had spoken about for years without having sufficient confidence to put their plans into effect. The weekly make for the new mill was between 1,500 and 1,600 tons, which would go some way towards meeting the demands of the larger South Staffordshire ironmasters who were now rolling

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(81) Colliery Guardian, 7/2/1908.

down half-product steel into sheets, hoops, strips and to some extent bars as well. To win these consumers over, Hickman knew that his new mill would have to produce the steel to sell at below Welsh and Continental prices; in fact, his production costs were said to total about 80/- per ton, which compared very favourably with the 85/- production costs of the Welsh steelmakers who had to pay a further 7/- to 8/9 a ton in railway costs. However, Hickman's main opponents were the foreign producers who, on hearing of this new source of supply for the Black Country finishing trades immediately dropped their prices by 2/6 per ton. Sheet-makers were now offered German steel billets and bars at 90/- but delivery dates could not match those promised by Sir Alfred Hickman, Ltd.. For the first time, agents of both Belgian and German houses left the district with empty order books. (82)

Competition was most severe throughout 1910 in the common bar trade, especially from Belgium. Belgian rolled iron was stronger than the German, with the result that it gained preference with consumers for use in the nut and bolt trades. Belgian No. 2 iron hit the Darlaston district very hard, selling at £5/11 or less per ton in 1910. The local trade was so disorganised that few bar producers were willing to risk quoting a price:

"Everything has become a matter of negotiation between buyer and seller. Black Country makers say they cannot produce at less than £5/15 to £6 delivered, whereas the Belgians are prepared to do business at £5/10." (83)

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(82) One result of Hickman's initiative was to be seen in a change of policy on the part of the South Wales steelworks - instead of relying on Black Country makers of galvanised and black sheets to take their half product Bessemer and Siemens bars they had decided to go into the finished sheet business themselves. This was described as "a great compliment to the success of the Staffordshire new steel introduction, but it is not an auspicious one for the Midland galvanisers". Colliery Guardian, 8/4/09.

(83) Colliery Guardian, 24/6/10.

Naturally, the "dumping" policy of the Belgians pleased South Staffordshire consumers, no matter how hard it hit the ironmasters themselves. Many of the smaller firms in the district engaged in the nut and bolt trade were kept going by the cheap foreign material because they were able to produce the finished article at prices which the larger works, with their heavier dead charges and their greater obligation to use British materials, could not touch. The higher-class material of the larger firms had to come down in price in order to find buyers, with the result that very little profit was made.

Whereas in the past there had been short bursts of Belgian competition, in 1910 it was prolonged. Even the steelmakers were affected (Belgian steel bars were offered 80/- per ton f.o.b. Antwerp or 93/6 delivered Midland stations compared with local quotations of 100/- to 102/6), but the Spring Vale Works were reported to be full of work in August 1910. They had decided to withdraw all their pig iron from the open market and themselves convert the entire product of their five blast furnaces (a sixth furnace was blown in in September) into steel. Even then their weekly make of 3,000 tons of pig iron was inadequate and buying of pig iron from outside sources was found to be necessary. Local consumers of semi-finished steel were only too anxious to order from the Continental makers, particularly when Welsh supplies dried up in October. In December, too, one of the largest sheet manufacturers in the district placed an order for 10,000 tons of steel bars with an American steelworks - at 91/3 a ton delivered compared with 94/- (Belgium) and 97/6 (United Kingdom). This large order going to the Americans seemed greatly to upset the Continental manufacturers, with the result that they immediately advised their agents to drop their prices still further. The Birmingham correspondent of the Colliery Guardian wrote:

"No sooner are American shipments to this country advised than down come Continental prices, with the view, it is supposed, of keeping

the English markets to themselves. If American price-cutting should drive prices further down Belgian billets might possibly fall to 80/- a ton".(84)

After several false starts in the summer of 1911, trade began to revive once more in the Black Country. Belgian steel virtually disappeared from the market and even though considerable quantities of bar iron were still coming into the Darlaston district for the nut and bolt trade towards the end of the year prices for the local bars of similar quality continued to rise; by November local common bars could not be obtained for under £7/15 to £8 per ton. Even the manufacture of steel girders, for so long the preserve of Continental makers, was becoming a lucrative industry for two of the Black Country steelworks, Spring Vale and Round Oak. The moment seemed right for twenty of the country's leading steelworks to aim another blow at the foreign competition, and it was interesting to note that seven Midland firms were signatories to the steel rebate scheme: Round Oak, Alfred Hickman, Ltd. (sections only), Patent Shaft and Axletree Company, Stewarts and Lloyds, Ltd., Lilleshall Company,, Shelton Iron and Steel Company and the Frodingham Iron and Steel Company. A rebate of 5/- per ton was offered on a list of products to those consumers who confined their purchases to the twenty firms. No attempt was made to curb the imports of semi-finished steel - valued annually at £3.5 millions - because home demand in periods of expansion was largely in excess of supply and it was in this branch of the steel trade that the Continental and American producers pursued their "dumping" policy with the greatest vigour. The twenty-strong 'Combination' concentrated on curbing the imports of iron and steel plates, sheets, angles and shapes valued at £1.5 million per year. The Colliery Guardian correspondent commented:

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((84) Colliery Guardian, 9/6/11.

"The combination is using the same weapons as the Germans, for the rebate scheme has been in operation in Germany to encourage their export trade for several years past, and it is that which has so much increased the German steel exports to the British markets, including Staffordshire".(85)

Recovery in the Black Country was not without its setbacks in 1912; a serious strike in the local coalmining industry occurred in February and March and a number of the district's largest producers, including Alfred Hickman, Ltd., were forced to shut down completely for a time. Supply difficulties arose again with regard to semi-finished steel and what small quantities of foreign material came into the district were quickly snapped up. There were further serious labour difficulties in June 1913, and by this time severe Belgian and German competition had returned. Steel prices dropped drastically in October 1913 when Continental blooms and billets could be obtained in the district for 95/- to 96/-; the finished steel trade also had to face very keen Belgian competition and in Scotland the rebate scheme collapsed. Black Country common bar producers, who in 1913 could not produce the material under £6/10 to £6/12/6 a ton, found that Belgian No. 3 iron was coming into the Darlaston and Wednesbury districts for as little as £5/12/6 to £5/15 per ton. German gas strip was imported in February for £5/10 a ton, compared with the Gas Strip Association's price of £6/15 to £7. There was, in fact, no let-up in the competition until the outbreak of war in August 1914; then, of course, the sudden withdrawal of Continental bars and billets running at a weekly total of about 45,000 tons caused havoc throughout the whole country. Allowing for the fact that war profiteering was already slightly in evidence, it is just possible to assess the influence of foreign competition on home prices by looking at the market at the end of the

(87) The Iron and Steel Industry of Great Britain, J. G. Carr, W. T. Martin, L. S. Gresham, P. H. Payne,

(85) Colliery Guardian, 3/14/11.

second week in August 1914:

"In the abnormal circumstances it is impossible to state firm prices. In pig iron, for instance, the increase asked for varies from 5/- to 10/-. To meet the fresh advance in pigs makers of finished iron have been compelled to advance values. Makers of gas strip put on £1 a ton earlier in the week ... Relieved of the pressure of foreign competition, producers of small rounds, squares and flats have raised prices to £7/10 a ton delivered Birmingham, which represents an advance of about 17/6 a ton. The advance in second-class bar iron is about 15/- to 20/- a ton and the current quotation is £7/10 at works. Marked bar makers decided to raise prices from £8/10 to £9. Wire makers, who get the bulk of their raw material from abroad, declared an advance of £2 a ton. Finished steel is now £1 dearer than it was a fortnight ago, and billets 15/- a ton".(86)

The apparent failure of the United Kingdom iron and steel industry to face up to increased foreign competition in the period before the First World War has occupied the attention of a number of historians over the last ten years or so.(87) Most have accepted the findings of Duncan Burn, although it has been pointed out that he tended to concentrate too much upon the Bessemer steel sector to the neglect of open-hearth, a point, in fact, which in no way affects his main conclusions. A small number of writers, notably the American Peter Temin, have exercised a more independent line of approach, and some of Burn's conclusions have been turned upside down. Basically, however, the picture remains the same:

i. the British industry experienced comparative stagnation because of the smallness in the growth of her home market demand. Consumption of

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(86) Colliery Guardian, 14/8/14.

(87) The list includes J.C. Carr, W. Taplin, T.S. Orsagh, P.L. Payne, S.B. Saul, W.A. Sinclair and P. Temin



iron and steel per head of the population in the United Kingdom rose only slightly in the period after 1880, compared with substantial gains in the United States and Germany.

Average Annual Production of Pig Iron per Head of Population (Cwt.)

	1889-3	1894-8	1899-1903	1904-8	1911	1912
U.K.	3.9	4.2	4.2	4.4	4.2	3.8
Germany (inc. Lux.)	1.9	2.3	3.0	3.7	4.7	5.3
Belgium	2.5	2.8	3.0	3.6	5.3	6.0
U.S.A.	2.6	2.6	4.1	5.0	5.1	6.2

Average Annual Production of Steel per Head of Population (Cwt.)

U.K.	1.8	2.0	2.4	2.7	2.9	3.0
Germany	*	*	*	3.4	4.5	5.1
Belgium	0.8	1.7	2.2	3.6	5.7	6.5
U.S.A.	1.3	1.8	3.3	4.4	5.1	6.6

(88)

ii. this slow rate of growth in the United Kingdom, more than covered by the surplus production capacities of the United States, Germany and Belgium, meant that there was little dynamic justification for the leading iron and steel manufacturers to pull out of the "Great Depression" doldrums with large capital expenditure programmes. Hence, the opportunity to use the latest technology was less evident in the United Kingdom than on the Continent or in the United States. Very few new large-scale plants were designed and put down and those that were tended to suffer from incomplete innovation policies. Such a combination of factors, nevertheless, led to a considerable increase in the amount of iron and steel imported by the United Kingdom.

Description of article (tons)	<u>United Kingdom Net Imports (Selected)</u>				
	1908	1909	1910	1911	1912
Pig Iron	64,704	104,211	171,491	175,099	216,743
Wrought Iron	78,246	90,749	89,263	111,967	162,028
Steel 'semis'	560,425	550,401	558,973	827,191	873,215
Plates & Sheets	55,234	65,845	85,431	112,649	100,420
Wire Rods	40,291	55,135	78,175	88,754	95,741

(89)

(88) 1913 Board of Trade Returns, p. 51.

(89) Ibid, extracted from material on page 68.

iii. this slow rate of growth also tended to discourage men of real managerial ability from coming into the industry. Professor Habakkuk is, indeed, the main exponent of this thesis, especially with regard to the whole of British industry; the "Great Depression" was the cause of inferior management in many sectors of British industry, not the result of it. Nearer the truth as far as the iron and steel industry was concerned, however, was the fact that entry into the industry was extremely difficult, even if it was possible to acquire the right type of training and scientific expertise.

iv. Duncan Burn's close study of comparative labour costs and total production costs both illustrates the difficulty of finding a complete picture, and of the doubtful value of such a study towards explaining the growth of foreign competition in iron and steel

v. the difficulty of quantifying the relevance of a number of factors can, indeed, encourage some historians to dismiss them. Higher freight rates, poor scientific and technical education systems, the virtual non-existence of close scientific control in the production processes, a social system which ossified the relationships between masters and men and prevented the easy movement of skilled men upwards, the failure in the United Kingdom to develop adequate marketing techniques and structures, the apparent lack of understanding on the part of the different governments of the period - these are, nevertheless, all very relevant factors towards explaining why the United Kingdom tended to lag.

vi. occasionally, historians writing about the iron and steel industry have fallen into the error of viewing the performance of the United Kingdom industry solely in the light of what had gone before. In other words, too much has been made out of the dwindling percentages of total world production and trade in iron and steel goods retained by the United Kingdom industry. It would appear that the almost total domination by the United Kingdom industry in the mid-Victorian period was the norm. A

quite different picture emerges if the figures for 1885-1913 are compared with those for periods after the First World War:

Pig Iron Production (000 tons)

<u>Year</u>	<u>G. B.</u>	<u>Germany</u>	<u>U.S.A.</u>	<u>Belgium</u>	<u>World</u>
1870	5,960	1,240	1,710	560	11,800
1880	7,750	2,430	3,840	680	18,100
1890	7,900	4,030	7,600	820	26,700
1900	8,960	7,430	9,450	820	39,700
1910	10,010	12,890	27,300	1,820	64,700
1920	8,960	6,930	36,930	1,100	62,900
1930	6,190	9,540	31,750	3,350	79,400

Steel Production (000 tons)

1870	220	130	40	-	510
1880	1,290	320	1,250	130	4,180
1890	3,580	2,100	4,280	220	12,280
1900	4,900	6,360	10,190	630	27,830
1910	6,370	12,890	26,090	1,910	59,330
1920	9,070	8,400*	42,130	1,230	71,120
1930	7,330	11,360	40,700	3,420	93,330

The South Staffordshire iron trade was already past its peak, and had undergone major structural alterations, when the United Kingdom industry as a whole had to face strong foreign competition. Unfortunately, the workings of competition only heightened the weaknesses of the local in-

Output of Pig Iron of S. Staffs.(1), N.E. Coast(2), N.W. Coast(3), S. Wales(4) and Scotland(5) (000 tons).

	(1)	(2)	(3)	(4)	(5)	U.K.
1855	754	299	48	840	828	3,218
1865	693	1,112	364	845	1,163	4,825
1875	393	2,018	1,182	1,046	902	6,381
1890	327	2,837	1,635	825	737	7,904
1899	415	3,251	1,766	929	1,171	9,421
1905	430	3,486	1,521	912	1,375	9,608
1910	495	3,679	1,398	788	1,428	10,012

dustry and, because Birmingham and the Black Country was such a large market for iron and steel, it was inevitable that foreign producers would be attracted to the district in their search for buyers. Of the greatest importance was the structure of the South Staffordshire <sup>in during</sup> <sub>L</sub> for, despite some

degree of concentration, industrial ownership remained dispersed. Too many small units of production had come into being in the 'good years' and at no time did the district throw up capitalists prepared to stamp out local competition. Furthermore, apart from going outside the district to secure supplies of coal and ironstone, the two largest producers of steel in South Staffordshire, Round Oak and Spring Vale, remained local firms. Within the finishing trades, and apart from a few notable examples of link-ups with firms in South Wales, South Staffordshire firms tended to remain small, poorly organised and with only limited plant renewal. Separate work-sites throughout the district were acquired by such firms

Local Distribution and Growth of Concentration (Pig Iron)

<u>District</u>	<u>1873</u>			<u>1883</u>			<u>1912</u>		
	<u>Firms</u>	<u>Works</u>	<u>Furns.</u>	<u>Firms</u>	<u>Works</u>	<u>Furns.</u>	<u>Firms</u>	<u>Wks.</u>	<u>Furns.</u>
Cumberland & Lancs.	17	18	92	24	25	105	10	17	64
Cleveland & Durham	27	32	132	31	35	156	20	26	115
Midland Counties	21	23	76	29	31	106	23	25	89
W. Riding	9	12	40	12	13	46	7	7	22
Scotland	21	27	156	20	27	147	12	17	102
Staffs & Salop	<u>60</u>	<u>73</u>	<u>207</u>	<u>46</u>	<u>53</u>	<u>143</u>	<u>18</u>	<u>19</u>	<u>62</u>

as Walker and Yates (Gospel Oak, Tipton Old Church Works, Regents Canal Bridge Works, Limehouse, Mitre Works, Wolverhampton) or J. Bagnall's (Goldshill Ironworks, Capponfield Works, Leabrook Works), with fairly large amounts of capital involved, but they remained dispersed. It was at this point that the internal transport systems proved expensively inadequate; at every boom period, the railway companies found it virtually impossible to keep the freight wagons running to schedule and goods piled up on the wharves of the various works. Although South Staffordshire ironmasters complained about supplies of iron ore, and especially the cost of transport, the district was, in fact, in a most favourable position to receive ores from Northamptonshire and other midland counties. If supply difficulties were encountered it was in part because of the smelters' reluctance to receive full train-loads of ore; besides, they

showed little initiative when they failed to acquire the ownership or mining rights to ironstone workings in the East Midlands. Their reliance upon 'foreign' supplies of ironstone put them in sharp contrast with producers on the Continent or in the United States. Perhaps even more significant was South Staffordshire's almost total dependence upon outside supplies of metallurgical coke. In times of normal trade, this was not too much of a problem; excellent coke could be obtained from South Wales, Derbyshire and South Yorkshire. However, in times of heavy demand for coke reliable supplies for South Staffordshire proved both expensive and difficult to maintain. At virtually every period of high prices for locally-produced pig iron, the profits available to the blast furnace operator were drastically reduced by coke prices which rose between 50 and 100 per cent. Indeed, dear coke tended to push up the price of the pig iron beyond the reach of the finishing trades, members of whom were themselves having to face severe foreign and domestic competition. It is not surprising that the highly-priced local product should have encouraged competition from outside producers, and especially from the rapidly expanding industries on the Continent. Frequently, amazement was expressed by contemporary observers that local pig iron producers failed to expand their productive capacities in the periods of high demand; the shortage of reasonably-priced coke was the answer. Furthermore, because of this situation the district's producers could not meet the demand, thus creating additional encouragement for foreign producers to come into the Birmingham and Black Country market. It is significant that many Black Country firms engaged in the finishing trades had, by 1900, become totally dependent upon foreign steel 'semin' to stay alive in a competitive sense.

## Appendix 1: Coke Manufacture, 1850 - 1914.

The manufacture of coke for metallurgical purposes in Britain dates from the practice of Abraham Darby in Coalbrookdale, Shropshire, in the early eighteenth century. For various reasons, not least the Quaker mentality of the Coalbrookdale ironmasters, the process was slow to show development, but by the end of the eighteenth century and the beginning of the nineteenth the 'hearth' process had been developed by many different people on many different coalfields. Speaking as late as 1892, E.P. Martin, in his Presidential Address to the Iron and Steel Institute, pointed out that "to this day Abraham Darby's plan of coking in heaps is still carried on at Blaenavon".(1) Early in the nineteenth century, a yield of 50 per cent "seems to have been common"(2), but at Grazebrook's Netherton Ironworks, near Dudley, where the process was in use almost until the Second World War, a 75 per cent yield "had been made possible". (3) In Scotland and parts of South Wales, the 'hearth' process was never very satisfactory, and it was totally unsuitable for the "friable and strongly-swelling coals" of the Durham area. The beehive oven, described as "the first 'closed' oven to which air was admitted for the partial combustion of the coal"(4) was "developed as a means of utilizing the swelling and caking properties of the smalls derived from coals with a carbon content of 85 per cent and upwards".(5) Such coals were to be found in Durham (Victoria and Busty), South Yorkshire (Parkgate, Barnsley and Silkstone), West Yorkshire (Halifax Soft and Winter), Lancashire (Mountain Mine), Derby (Waterloo) and South Wales (Two-Foot-Nine) (6).

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(1) J.I.S.I., 1892, p. 29.

(2) Ed. R.A. Mott, The History of Cokenaking, 1936, p. 27.

(3) S.H. Beaver, *op cit*, p. 135.

(4) R.A. Mott, *op cit*, p. 29.

(5) S.H. Beaver, *op cit*, p. 136.

(6) W. Smith, An Economic Geography of Great Britain, rep. 1961, p. 318, extracted from R.A. Mott and R.V. Wheeler, The Quality of Coke.

The growth of the beehive oven in Britain became synonymous with Durham coke manufacture and was in every way related to the tremendous growth of the Cleveland iron and steel industry after 1850. As late as 1853, it has been estimated that the demand for coke throughout the British iron industry was about one million tons. This small figure was due to the fact that raw coal was used in many of the main iron-producing areas, especially Scotland (where 'splint' coal was used with the Lanarkshire 'blackband' ironstones), South Staffordshire, Shropshire, Derbyshire and the Merthyr area of South Wales. Throughout the 1850's and 1860's, however, the production of iron in north-eastern England grew from 20,000 tons in 1847 to 2,400,000 tons in 1880, whilst on the West Coast production rose from 100,000 tons in 1860 to 1,600,000 tons in 1880. Increases also occurred in Lincolnshire, Northamptonshire, South Yorkshire and Derbyshire. The demand for coke rose proportionately to this increased production in the newer iron and steel areas. By 1880, the figure for coke required by the ironmaster had grown to seven million tons - "an amount which has satisfied the needs of the iron industry even in modern times".(7) Durham County, in fact, was producing five million tons of coke in 1880 which, in addition to the County ironmasters like Sir Lowthian Bell, was supplied to other districts as far afield as Cumberland.

R.A. Mott has correctly argued that the coke-making industry, "on the scale of production practised to-day", developed mainly between 1860 and 1880. Indeed, it was an industry based upon production in the beehive oven. Demand for coke altered very little over the next twenty years for the very good reason that the production of pig iron in Britain increased only slightly. In other words, the coke producer was faced with a stagnating market in the period 1880 to 1900. Mott further argues that this was "important, for it was in these later years that the by-product oven

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(7) R.A. Mott, *op. cit.*, p. 46.

was developed". He points out that the developments made in Germany to the by-product ovens came about because of the great expansion of the iron and steel industry there; using this line of argument he suggests that the lack of development in Britain arose because there was no corresponding expansion of the British iron and steel industry. However, this is too much of an over-simplification: in Belgium, for example, where pig iron production rose from only 0.70 to 1.06 million tons annually, there was considerable progress made with regard to by-product recovery and non-recovery retort ovens. Besides, in Britain between the periods 1900-4 and 1910-13, when Mott admits that British manufacturers took a much greater interest in by-product ovens, the production of pig iron rose only a little. Indeed, there were more fundamental and far-reaching reasons why Britain "fell behind" the practice of some Continental countries in coke manufacture.

The by-product recovery oven was introduced into Britain at about the same time as in France, Belgium and Germany. Twenty-five Simon-Carves ovens were erected by Messrs. Pease and Partners at Crook in County Durham in 1882, and the number was doubled the following year.(8) In France, the Societe Carves had obtained the Knab patents(9) and in the 1860's had led the field in the condensation of tar and ammonia. The so-called Carves oven was developed over the next decade or so at the works of the Terrenoire Company near St. Etienne. When H. Simon addressed the Iron and Steel Institute in the 1880's, he pointed out that the 'Simon-Carves' oven was then in use in Belgium, Silesia, Austria and France. A coke-yield of 75 per cent "was not uncommon, with 2.3 per cent

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(8) J.I.S.I., 1882, 1, p. 189.

(9) Carl Knab of St. Denis, near Paris, built an externally-heated oven at Commentry in 1856.



of tar, besides ammoniacal liquor". Mott states that the Carves oven "may be accepted as the first oven which produced, at the same time, a metallurgical coke and a high temperature tar".(10) There is a little doubt as to who was the first to introduce the by-product recovery oven into Germany, but by 1882 there were two types in operation. Dr. C. Otto, who had been building Coppee non-recovery ovens since 1867, built some ovens in Westphalia in 1881. They were of an experimental nature and were not in regular operation until the following year.(11) Mott, however, gives preference to Albert Hüssener as being the first successful builder in Germany. He erected 50 Knab-Carves ovens.(12) The first satisfactory by-product oven with vertical flues - the Otto-Hoffmann - followed in 1883 and a modified version became the most popular by-product oven in Germany over the next ten years. By 1885, Germany had taken the lead in having the highest number of by-product recovery ovens.

Number of Otto-Hoffmann Ovens in Germany, 1884-1900.

<u>Year</u>	<u>Number</u>
1884	40
1885	210
1889	605
1892	1205 (13)
1900	3000 (14)

Arrangements for the recovery of by-products were certainly not cheap. Lürmann estimated that the cost of a battery of six ovens complete would be £36,000, but a saving of 3/9 per ton of coke was possible. A few years later, F. Simmersbach pointed out that in the Dortmund area the

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(10) R.A. Mott, *op cit*, p. 67.  
(11) J.I.S.I. , 1885, p. 622.  
(12) *Ibid*, and R.A. Mott, *op cit*, p. 72.  
(13) F.W. Lürmann, Stahl und Eisen, xii, 1892, p. 194.  
(14) R.A. Mott, *op cit*, p. 75.

*Stahl und Eisen*, 1873, p. 119.

"number of the different types of coking-ovens in use (had) undergone diminution".(15) The Smet and Appolt ovens had disappeared and the Otto-Hoffmann type was in general use. A year later, he pointed out that the "modern form of the Otto oven" was the one which had shown the maximum annual yield - 1450 tons.(16) In the 1890's, coke production in Germany had increased by more than 3.5 million tons, or 55 per cent, to 9,960,740 tons in 1897. 70 per cent of all the coke made in Germany was produced in the Ruhr district, one-half of which output came from the by-product oven. By 1902, 42 per cent of Germany's coke was coming from by-product ovens, or 6,300,000 tons. In addition, there were 294,000 tons of tar and 84,000 tons of sulphate of ammonia.(17)

Belgian coke manufacturers were forced in the 1850's to find cheaper coke supplies than from the bituminous coal in the Charleroi district and Liege. Speaking in 1873, M. Auguste Gillon, Professor at the School of Mines at Liege, said that whereas England was "only just concerning herself with a system of ovens", Belgium "has long since passed through the period of transformation". He went on to say:

"The old forms of ovens, with solid walls, which are known as bakers' ovens and which are discharged by means of a rabble, many of which are still to be seen in England, have long since disappeared in Belgium, where they have been replaced by ovens having flues, and being emptied by steam power".(18)

The Smet system - "the oven with two doors and a mechanical ram" - brought a saving of 2.45 francs per ton for the Belgian manufacturer. The Dulait, Coppee and Appolt ovens were all in use in Belgium - they

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(15) J.I.S.I., 1897, p. 387.

(16) Stahl und Eisen, xviii, pp. 641 - 647.

(17) J.I.S.I., ii, 1902, p. 39.

(18) J.I.S.I., ii, 1873, p. 339.

were non-recovery ovens and they emphasise the point that, whilst Belgium

Gillon's Estimate of Use of Coppee and Appolt Ovens

<u>Type of Oven</u>	<u>Country</u>		
	<u>England</u>	<u>Prussia</u>	<u>Belgium</u>
Coppee	30 (19)	1305	524
Appolt	-	138	192

had to take second place to Germany in the case of by-product recovery, she led in the field of making a satisfactory metallurgical coke from low volatile coals. Areas in Britain possessing similar low volatile coals - South Wales and Monmouthshire especially - were slower to adopt such ovens.

Following the efforts of Henry Simon in 1882 to establish a by-product oven in Britain, considerable attention was given to the subject but little material progress was made. The dominating force in the Cleveland district, Sir Lowthian Bell of the Clarence Iron Works, admitted in 1885 that about one-sixth of the solid carbon was wasted in the beehive oven, which amounted to an annual wastage of £700,000 in the Durham area alone.(20) Nevertheless, Bell believed that the extra expense did not warrant abandoning beehive ovens for Simon-Carves ovens. He had experimented with some 5,605 tons of coke from the Simon-Carves ovens at Bearpark, and had reached the conclusion that some 15 per cent more coke was necessary to produce a ton of pig iron than when beehive coke was used in the blast furnace. Sir Bernhard Samuelson, who had conducted his own trials with similar coke, disagreed with Bell's findings. The latter had probably failed to take the greater density of by-product coke into full consideration and had not reduced the amount of coke charged. Charles Cochrane also shrewdly commented on Bell's experiments: he pointed out that "by employing only one of the many improvements and

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(19) J.I.S.I., 1, 1885, p. 58.

(20) Ibid.

using old equipment" you would be most unlikely to obtain "satisfactory results". One of the possible reasons for opposition to by-product coke was expressed by E. Williams of Bolckow-Vaughan in 1885. It must be stressed that Durham beehive coke was an excellent fuel for the blast furnace, and any alteration would be frowned upon, especially if it meant "saving at the collieries and loss at the blast furnaces".(21)

In other words, the ironmaster would not like to pay the same price for by-product coke as he would pay for beehive coke. In 1898, J.H. Darby, the managing director of the Brymbo Steelworks, was anxious to point out that retort coke "fetched the same price as beehive". German producers had viewed the matter in a different light; the recovery of by-products was a means of reducing the final cost of the coke to the ironmaster. Williams, however, was not correct in saying "that there was not at present known to them any more efficient mode of making coke than the (improved) old-fashioned Durham beehive oven".(22)

The next important address given to the Iron and Steel Institute on the subject of by-product recovery ovens was in 1898 by J.H. Darby. Between 1890 and 1898, progress in Britain had been painfully slow. Kubale had visited the Durham area in the mid-1890's and was surprised to find that "the recent improvements in the construction of coke-ovens appears to have remained to a certain extent unnoticed".(23) Henry Simon had formed a limited company - the Durham Coke and By-products Company, Ltd. - to demonstrate the advantages of the Simon-Carves oven, and in 1893 seventy such ovens were built at Malton Colliery in Lancashire. At about the same time, Sir Bernhard Samuelson, obviously determined to put his stated differences of opinion with Sir Lowthian Bell into effect, also put down seventy Simon-Carves ovens. In 1894, Darby decided to put

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(21) J.I.S.I., 1885, 1, p. 83.

(22) Ibid.

(23) Zeitschrift für das Berg-Hütten und Salinenwesen im preussischen Staate, xliii, 1895, pp. 34-68.

down twenty-five retort ovens. In coming to this decision, Darby showed just how far his fellow ironmasters in Britain were behind their German counterparts. He was of the opinion that "well-made beehive coke left little to be desired from a blast-furnace point of view", but he was then persuaded that "well-made retort coke" was "economical in the blast-furnace".(24) A. Thielen, managing director of the Phoenix Steelworks at Ruhrort, had a battery of Simon-Solvay ovens at the Phoenix works and he had supplied Darby with evidence of the undoubted excellent quality of retort oven coke. Darby's own experiments at Brymbo had substantiated Thielen's evidence. As an additional factor in Darby's experiments at Brymbo was the point that "there are fuels which will not coke satisfactorily in beehive ovens, but which produced a marketable coke in the retort oven". Having operated his ovens for four years, Darby could speak with some authority before the Institute. He dealt with the various British-held prejudices about retort oven coke, denying that such coke contained more water than beehive coke. This idea had arisen because of the practice of watering or quenching outside the retort oven. A Mr. Charles Wood, during the discussion which followed Darby's paper, insisted that "he had seen the coke arrive at the furnaces with water actually dripping out of the bottom of the trucks".(25) This Darby strenuously denied as being typical, and he was supported by Sir Bernhard Samuelson. Darby admitted that retort oven coke was not so "bright in appearance as beehive, and it is different in shape", but the retort oven gave a better yield of coke per ton of fuel. It is difficult to accept that practical men should have felt strongly about the appearance of beehive and retort oven coke, but its poor appearance was often the main grounds for disliking the latter material. One opponent voiced the following description: "great big solid squares, very often with a crust

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(24) J.I.S.I. 1898, 1, p. 44.

(25) Ibid, p. 57.

on it, perfectly spongy on the top, and fearfully heavy to handle". C. Lowthian Bell referred to it as "the dirty-looking 'cinders'". Indeed, these are adjectives used by prejudiced men.

Despite support from both German and Belgian manufacturers, Darby failed to convince Sir Lowthian Bell that the blast furnace did not consume more retort oven than beehive coke. A Belgian speaker, A. Greiner, mentioned that Solvay ovens had been in use at Seraing for ten years and "the coke was not very different from that produced in their other ovens; practically they did not find any difference".(26) The by-products brought in a saving of one and a half to two francs per ton of coke. Dr. Ludwig Mond was more outspoken in his criticism of English producers. He failed to understand why they were so behind their Continental competitors, especially as England still made more coke than the rest of Europe together. Mond stressed that the retort oven of modern design could be adopted for very poor coals, as in Belgium, "but also in Silesia and Austria, and more practically on the Rhine, where bituminous coals were used which were very much the same as those generally used in this country".(27) For fifteen years, Mond claimed, he had been producing coke at "very nearly the cost of the fuel that he put in, ton for ton... That ought to be sufficient to shew to any practical man the great saving which the new system effected over the old system". Bell refused to accept this, and peevishly stated "coal varied in its quality, and what might suit one district might not suit another".

An interesting point to emerge from the discussion which followed Darby's paper was the fact that the Clarence Works had spent some time experimenting with the idea of recovering by-products from their beehive

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(26) Ibid, p. 56.

(27) Ibid, pp. 60-61.

ovens. J. Jamieson had for some years been trying to find a way of doing just this(28), but had encountered too many difficulties. He had been told by Messrs. Bell Brothers that they had intended trying to recover the by-products from 100 of their own beehive ovens but they had then abandoned their intentions. Consistently over the years, Sir Lowthian Bell had led the opposition to using coke from which the by-products had been recovered; he had now moved away from this view but, instead of installing new, proven retort ovens, he had preferred to try with his antiquated beehive ovens. Reluctantly, it would seem, Bell had to turn to the Continent for help. "Many different types of retort oven" were looked at by the management of the Clarence Works, and in 1904, C. Lowthian Bell was able to announce to the Iron and Steel Institute: "At Clarence we think we have solved the question of retort oven coke".(29) Somebody from the Clarence Works had visited Germany and the Hüssener ovens working near Essen had been brought "to our notice". In January 1901, after some Tursdale colliery coal, "washed and prepared for coking", had been sent to Germany, sixty Hüssener ovens had been put down at the Clarence Works. The plant was doubled within a few years, so satisfied were they with the coke they were getting. Bell was not very generous to the Germans when he pointed out to members of the Institute that the "coke made at Clarence" was "better than that made experimentally in Germany". It was equally as good as beehive coke and, whereas beehive coke took from 72 to 96 hours to burn, "and then it is often left in the oven for 10 or 12 hours before being drawn", in the case of retort coke the "operation is completed in about 32 hours".(30)

What surprised so many members of the Institute was Bell's claim that

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(28) R.A. Mott, op cit, p. 54 and J.I.S.I., 1898, i, p. 67.

(29) J.I.S.I., i, 1904, p. 201.

(30) Ibid, p. 191.

"at last the question was solved of retort versus beehive ovens, and than it was solved by the adoption of the Hüssener oven".(31) W. Hawdon, of Middlesbrough, accused Bell of suggesting that the Hüssener oven was "the only one in operation from which they could get those results".(32) At the Newport Works, they had for some time obtained similar results with coke from the Otto oven. Hawdon claimed, and later developments support him, that the Otto-Hilgenstock waste-heat vertically-flued oven, which replaced the Otto-Hoffmann in Germany in 1896, was capable of better all-round results than the Hüssener oven. Indeed, the latter oven had not altered much since its introduction in the early 1880's. F.A.E. Samuelson (later Sir Francis Samuelson) was just one of many British manufacturers who had been sent by his firm to visit coking plant in Germany. He had met Albert Hüssener in 1895, and had been impressed with the latter's oven, but he had since found that the Otto-Hilgenstock was a better oven. His firm had put down 130 such ovens. Several people pointed out that the illustrations which accompanied Bell's paper were of earlier models than those in existence.

The year 1904 seemed to mark a turning point in the development of retort ovens in Britain. Rapid development took place in Yorkshire, followed by Lancashire, Scotland, Derbyshire, North Staffordshire and the West Coast. In South Wales, despite the fact that Windsor Richards had

Coke Manufactured by Different Types of Ovens  
in United Kingdom, 1900-14.

<u>Year</u>	<u>Total Make</u> <u>(Million tons)</u>	<u>Beehive</u> <u>%</u>	<u>Non-recovery</u> <u>%</u>	<u>By-product</u> <u>%</u>
1900	10.0	80	13	7
1907	12.3	68	13	19
1912	10.7	45	10	45
1914	11.0	31	7	62 (33)

for some considerable time pushed the retort oven, progress was slow. No doubt, this was primarily due to the fact that the by-product yields

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(31) Ibid, p. 205.

(32) Ibid, p. 202.

(33) R.A. Mott, op cit, p. 85.



from the low-volatile coals were lower than in other areas. It was not before the First World War that the Coppée non-recovery oven really gave way to the by-product oven. The growth of by-product ovens coincided with the growth of a coking industry outside the Durham area, and the resulting relative decline of the latter area.

Hitherto, no mention has been made of coke production in the United States. Indeed, apart from one member quoting from the 1896 United States Geological Survey in 1898 during the discussion which followed Darby's paper on the retort oven, the first time the American industry was mentioned at the Iron and Steel Institute with any degree of feeling was in 1904. Enoch Jones, of Cardiff, was a convinced opponent of the retort oven and he used the possible slow development of by-product ovens in the United States to support his own views:

"... either they (the Americans) did not know a good thing when they saw it, or, having seen it, they were happy without it. They took a back seat compared with British producers with regard to the adoption of by-product coke".(34)

Dr. W. Hiby, of London, chose to correct Jones when he pointed out that the United Coke and Gas Company, who owned the patent rights for the Otto oven in America, "had of late years built twice or thrice as many Otto ovens in the States and Canada as all the coke oven builders in England during the same period".(35)

Coke manufacture in the United States had, in the first half of the nineteenth century, become concentrated in the Connellsville area of Pennsylvania, located about fifty miles from Pittsburgh. Coke was first made there in 1831, but it was not until 1859 that pig iron was made in the Clinton blast furnace, Pittsburgh, with Connellsville coke.(36) By

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(34) J.I.S.I., 1, 1904, p. 211.

(35) Ibid, p. 214.

(36) The Connellsville coke region "did not rise to the dignity of a business until 1850", Iron Age, 21/7/81.

1880, the region had become the chief source of supply for the United States iron and steel industry. The beehive oven was by far the most popular type in use, and R.A. Mott has argued that it was chosen for the development of the American coke industry "in a period subsequent to that in Britain".(37) As well as the Connellsville district, coke was produced by 1900 or earlier in the following districts:

West Virginia (Pocahontas region)  
 West Virginia (principally along the slopes of Allegheny Mts.)  
 Alabama (principally in the district around Birmingham)  
 S-E Kentucky  
 Illinois  
 Indiana  
 Colorado  
 Georgia  
 Missouri  
 Tennessee  
 Virginia  
 Washington

The extent of the way in which Pennsylvania dominated the industry is seen in the fact that the state produced 13,798,893 tons of coke in 1900. Four Southern States - West Virginia, Alabama, Virginia and Tennessee - produced a further 5,629,926 tons, or 27 per cent of the total United States coke output per annum.(38) 388 different coke-making establishments existed, producing on average 53,000 short tons each year. The average output per oven in operation varied considerably, from 572 tons in Pennsylvania (highest) to 306 tons in Tennessee.

In the Connellsville district, some twenty years earlier in 1880, approximately 6,680 beehive ovens were in use, of which only 1,880 were owned by blast furnace operators. This meant that 4,800 sold to outside furnaces and foundries. However, over the next decade or so, the Carnegie Steel Company came to control a large number of coke ovens. Andrew Carnegie, in fact, invited H.C. Frick, of H.C. Frick and Company, the largest single operator in the Connellsville district, to become a partner in, and to assume a large measure of control over, the Carnegie Steel Company. With

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(37) R.A. Mott, op cit, p. 75.

(38) BITC Report, American Industrial Conditions and Competition, 1902, p. 29.

the formation of the Steel Corporation in 1902, some 18,000 coke ovens had come directly under the control of blast furnace operators. Returns for 1902 showed that only 2,719 ovens remained in the Connellsville district free to sell their coke to operators outside the United States Steel Corporation. In fact, on the evidence of Thomas Lynch, the President of the Frick Coke Company, "outside of the Steel Corporation, which owns 55,000 acres of the coke-making lands, there are not more than 600 or 700 acres available in the whole region".(39) The capacity of the coking plant under Lynch's control was about 875,000 tons per month, or well over 10.5 million tons annually. This figure was just a little short of the entire British output and more than the entire output of the whole German industry. Much of this coke was, indeed, consumed by the Steel Corporation, but traditional markets like that of Chicago were supplied as well.

Describing the manufacture of coke in the Connellsville area in 1902, J.S. Jeans thought that the British manufacturer "would hardly be likely to find, in the equipment, much improvement on his own conditions. Practically, beehive ovens are the only ones employed".(40) In the early 1890's, the Frick Company had introduced the crushing of coke which proved especially beneficial in foundry practice. Lynch informed Jeans that the Steel Corporation's coking concerns had not adopted any by-product ovens for the simple reason that they did not feel justified in

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(39) Ibid, p. 24.

(40) Ibid, p. 22. "They are built in both single and double rows, the former termed "bank", the latter "block" ovens. The only material variation is in the dimensions, which range from 10 ft. 6 ins. to 12 ft. in diameter, and from 5 ft. to 7 ft. high in the clear. It is usual to provide 3,000 crown and 1,200 lining bricks, with 120 bottom tiles, and 20 cubic yards of stone per oven".

running the risk of producing inferior coke for the purpose of realising an advantage which, "having regard to the remarkably low price at which they produced both coal (2/1 per net ton at the pit mouth) and coke (cost of conversion 1/8), appeared to be somewhat dubious".(41) However, Lynch admitted that they were "keeping their eye upon other by-product plants in West Virginia and elsewhere, and might find occasion to alter their opinion". A.L. Steavenson, writing in 1896, had defended the use of the beehive oven against all other types on very similar grounds.(42) As well as giving "good quality coke", the beehive oven enabled the waste gases to be used in raising steam. Besides, Steavenson emphasised that the price of retort-oven by-products was steadily declining.

However, the by-product oven had more than one supporter in the United States in the early 1890's. J.A. Montgomery attempted to calculate the enormous amount of by-products lost in the United States owing to the use of beehive ovens.(43) He estimated that the ovens which existed in the United States cost about 14 million dollars and that to replace them would cost 45 million. Against this he gave the waste in 1892 as 24 million. The Semet-Solvay oven did, in fact, cost £315 compared with £63 for the beehive, but the former lasted ten years compared with five for the latter. Besides, some Semet-Solvay ovens then in use in Syracuse, New York, produced by-products valued at £36, compared with £6 in the beehive oven. Another strong supporter of the retort oven was Joseph D. Weeks, for many years a government expert on the United States coke industry. In recording his death in 1897, the Journal of the Iron and Steel Institute stated that Weeks had taken a very active part in the introduction in the United States of by-product ovens developed in Europe.(44)

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(41) BITE 1902 Report, p. 24.

(42) American Manufacturer, lviii, p. 300.

(43) Proc. of the Alabama Industrial and Scientific Society, 5, pp. 10-19.

(44) J.I.S.I., 1, 1897, p. 317.

In fact, the Semet-Solvay ovens at Syracuse were the first by-product ovens to be erected in the United States. Twelve were put down by the Solvay Process Company in 1893. The Calumet Steelworks experimented with by-product recovery ovens in the same year, and ovens were erected by the National Coke and Fuel Company of Chicago.(45) Two years later, 120 Otto-Hoffmann ovens were in the course of erection at the Cambria Iron Works, Johnstown, Pennsylvania.(46) The returns for the 1896 Geological Survey showed that 13 more Semet-Solvay ovens had been added to the earlier ones at Syracuse, 75 of the same design had been built in Pennsylvania together with 30 Newton-Chambers ovens and 3 Slocum ovens. Coal mined on the slopes of the Allegheny Mountains in Western Pennsylvania had not proved very suitable for coking in the beehive. It was soft "and generally high in sulphur", but coke made in either the Otto-Hoffmann or the Semet-Solvay oven could be used in the blast furnace, "together with Connellsville coke, volume for volume".(47) By 1902, large installations of by-product ovens were being built for the purpose of coking Pennsylvanian "mountain coal" at the Maryland Steel Works of Sparrows Point, Maryland, the Lebanon Furnaces and the Lackawanna Company's new plant at Buffalo. Axel Sahlin, once an ironmaster in the United States but then at Millom in Cumberland, described the process thus:

" The coal is crushed and washed at the mines, and is then shipped to the coke ovens, which are located at the ironworks. In this way, the serious deterioration of the fuel by transport and rehandling is avoided. It is also recognised that the by-product oven produces from 12 to 15 per cent more coke from a ton of coal than is done in the older and still universally employed ovens of the beehive

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(45) Iron Age, xliii, p. 692.

(46) Stahl und Eisen, xv, 1895, p. 636.

(47) BITC 1902 Report, p. 429.

and retort type".(48)

A year later, it was estimated that there were 1,663 by-product ovens in operation and a further 1,346 in course of construction. The output of coke from by-product ovens in fact represented 5.44 per cent of the total production. By 1910, there were 4,000 ovens producing 7 out of a total of 34 million tons of coke.

It would appear, therefore, that the by-product recovery oven had won its fight for recognition in both the United States and Britain at about the same time. In both countries, there was a readiness to erect the ovens at the blast furnace, rather than at the colliery. The added transport costs were accepted as a necessary price to pay for a better product. However, whereas the British manufacturer was prepared more or less to imitate Continental practice, the Americans began to set the pace. They did not alter the design of the ovens, but introduced what has been described as the principle of the 'big make'. They increased the coke-making capacity by increasing the dimensions of the oven, a trend that was to influence development in all countries.(49) In Britain, the quality of the refractories used in the construction of coking ovens was sometimes inferior, and foreign bricks had to be imported. Indeed, many ovens were built in Britain by German contractors using Continental bricks. Disappointingly, the British industry had failed to make progress with the silica brick, and it was left to the Americans - especially the Cambria Steel Company - to pioneer the use of silica bricks (92 per cent silica) in the early years of the present century.(50)

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(48) Ibid, p.429.

(49) R.A. Mott, op cit, p. 115.

(50) Britain's failure to develop the silica brick - first manufactured at the old Neath works in 1856 - was not due to inferior geological resources but to inexperience in building - "a new material was being used and its properties were not well understood".(J. Laming, Refractories in the Gas Industry, 1900-50, in Ceramics, A Symposium, 1953, p. 674).

What were the reasons for the failure of the British coke producer to match developments either on the Continent of Europe, in the period 1880 to 1900, or in the United States after 1905? Essentially, they are identical to those which accounted for many of the shortcomings in the iron and steel industry in general. The 1928 Survey of the Metal Industries, compiled by the Balfour Committee on Industry and Trade, stated that iron and steel practice with regard to fuel economy in this country fell far behind German and Belgian developments because of Britain's "cheap and abundant supplies of coal".(51) The Committee listed the three technical developments as follows:

- (1) The invention of chamber ovens with heat recuperation and by-product recovery for the production of metallurgical coke.
- (2) The invention of an internal-combustion engine which could be used with cleaned blast furnace gas to generate electricity for the purpose of operating the rolling mills.
- (3) The cleaning of blast furnace gas by water-washing or by electrostatic methods.

These new methods of fuel economy necessitated the concentration of coking ovens, blast furnaces, steel works and rolling mills all on one site. However:

"The British iron and steel industry, having grown up for the most part in an earlier generation, before the changes described above were foreseen, had its coking ovens at the pit head so as to save carriage by moving coke instead of coal to the blast furnaces. They were, moreover, for the most part of the old-fashioned "beehive" type, which did not provide for the recovery and utilisation of the waste gases. Blast furnaces, steel works and rolling mills had been erected without much relation to one another".(52)

Related to this situation was the fact that "necessity for writing

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(51) Survey of Metal Industries, 1928, pp. 7-8.

(52) Ibid, p. 8.

off the heavy capital costs of the old plant, and the difficulty of raising even greater amounts of capital for the construction of new plant, were serious obstacles to change".(53) Certainly in the case of coke ovens the cost would have been high. The 760 ovens of Bell Brothers were valued at £42,560 in 1885. To have replaced them with Simon-Carves ovens would have cost £136,000.(54) It was never a shortage of money that caused British ironmasters to delay, as Sir Edward Carbutt stressed in 1897:

"... there was no doubt that in this country manufacturers were a little too conservative, and considering that they formed part of a country that had the money, and that money was so cheap that people did not know what to do with it, they need not be quite so frightened as they had been ... it was a great pity to be frightened at going ahead because they had old machinery, and did not want to spend the money".(55)

R.A. Mott, indeed, has suggested that "the chief reason why the by-product coke oven made so little headway in this country in the last twenty years of the nineteenth century was because a clear case could not be made out that it was more profitable than the beehive oven, on account of the low coke-making capacity of the early ovens, in comparison with the high capital cost".(56) Yet, is this really the case? Lürmann estimated that it was possible some 3/9 per ton of coke made could be saved, and Mond pointed out that for fifteen years he had produced his coke at no more than the cost of his coal. Darby went much further than this and gave a very thorough break-down of the costs-structure for both beehive and retort ovens to the Iron and Steel Institute.(57) These three men, in fact, gave a very creditable account of the financial advantages of the new system of coke ovens over the old - their contemporaries chose

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(53) Ibid, p. 8.

(54) J.I.S.I., 1885, 1, p. 92.

(55) J.I.S.I., 1897, 1, p. 109.

(56) R.A. Mott, op cit. n. 77.

(57) J.I.S.I., 1898, 1, pp. 46-7.



to ignore what they did not want to accept.

As well as the spirit of conservatism, which many writers have emphasised as being the chief reason why Britain fell behind in the application of technological improvements to industry, was an attitude of mind which Jeremiah Head summed up as follows:

"The chief opposers of improved methods were generally those who had not taken the trouble to make themselves acquainted with them".(58)

Besides, because of the lack of growth in the iron and steel industry generally in the period, fewer new faces appeared - "the average age of men at the top of existing firms was high and nepotism was most likely to occur".(59) It is perhaps not without significance that the Clarence Works took the decision to change from the beehive when it did. Sir Lowthian Bell had become a fading figure in an industry which he had greatly influenced from the floor of the Iron and Steel Institute for almost two generations. C. Lowthian Bell was not slow to offer his thanks to Greville Jones, who was then in charge of the Clarence furnaces, to Weldon Hanson, "for the care he exercised in the analyses", and to Dr. Roelofsen, "the manager of the Clarence ovens".(60) A further point which must be given its due weight was the backward position of British manufacturers in the application of science to industry. Few people could make a scientific case out as an explanation as to why the recovery of by-products did not take "something which the beehive coke retained." It is doubtful, too, if the labour force in the coke industry could adapt itself thoroughly to accept the more complicated retort oven. Many writers have stressed that the success of the retort oven depended entirely on the skill of the men who operated it. Later on, trade union agreements were to make changes difficult. Finally, it was not until 1915 that the formation of the Coke Oven Managers' Association gave the industry, in its own right, a forum for discussion and a means of furthering new knowledge in the industry.

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(58) J.I.S.I. 1897, 1, p. 111.

(59) H.J. Habakkuk, American and British Technology in the 19th. Cent., p. 213.

(60) J.I.S.I., 1904, 1, p. 200.

## Appendix 2.

List of Railway Basins in the Black Country.

<u>Railway Company</u>	<u>Name of Basin</u>
London and North Western	Monument Lane Tipton Mill Street Ettingshall Spon Lane Bloomfield Albian Great Bridge Darlaston Monmore Green Saltley Sidings Brownhills
Great Western	Tipton Factory Victoria Shrubbery Hockley Oldbury Bilston Withymoor Halesowen Hawne Wednesbury Swan Village Bromley
Midland	Primrose Great Bridge (with LNWR) Horseley Fields - Wolverhampton.

Appendix 3a State of the Pig Iron Department in 1852.

<u>Name of Works</u>	<u>Proprietors</u>	<u>Furnaces in blast</u>	<u>Furnaces out</u>
Pelsall	Davis, Bloomer & Sons	1	1
Hatherton	Woodall & Smith	1	1
Old Birchhills	F.C. Perry & Co.	1	1
New "	John Jones	3	1
Bentley Heath	Riley & Co.	0	4
Darlaston Green	S. Mills	3	0
New Darlaston	Addenbrooke & Co.	2	0
Chillington	Chillington Co.	4	0
Moseley	"	3	0
Stow Heath	W. Sparrow & Co.	3	2
Osier Bed	Osier Bed Co.	3	0
Priestfield	Exe. of late Lrd. Ward	2	1
Millfield	W. Riley & Son	2	1
Wolverhampton	Poole & Co.	2	1
Parkfield	Parkfield Co.	3	1
Bilston Brook	G. Hickman & Son	2	0
" New Furns.	Blackwell & Co.	2	0
Bovereux	Baldwin & Co.	2	0
Stonefield	G. & A. Hickman	0	1
Bilston	Jones & Murcott	3	0
Coseley	J. & T. Turley	2	0
Priorfields	H.B. Whitehouse	3	0
Deepfields	Pemberton & Co.	2	0
Capponfield	J. Bagnall & Sons	3	0
Ettingshall	T. Banks & Son	1	1
Hallfields	B. Gibbons, jun.	1	0
Wed. Old Park	Lloyd, Foster & Co.	2	0
Broadwaters	Colbourn, Groucutt & Co.	2	0
Wed. Oak	P. Williams & Co.	3	0
Willingsworth	Haines & Co.	2	1
Crookhay	G. Thompson & Co.	3	0
Goldshill	J. Bagnall & Sons	3	0
Toll End	Motteram & Co.	1	0
Horsley	Colbourn & Co.	2	0
Tipton Green	Gibbons & Roberts	2	0
Tipton	Cresswell & Sons	1	1
Park Lane	T. Morris & Son	1	1
Dudley Port	Hipkins & Son	2	0
Coneygree	Lord Ward	2	1
Oldbury	W. Bennitt	2	1
Union	P. Williams & Sons	3	0
Russell's Hall	Blackwell & Co.	3	0
Oak Farm	Firmstone & Co.	2	0
Shutt End	J. Bradley & Co.	4	0
Ketleys	B. Gibbons	3	0
Corbyn's Hall			
New Furnaces	"	3	0
" "	Hall, Holcroft & Co.	1	0
Corbyn's Hall	W. Mathews	3	1
Lays	Firmstone & Co.	3	0
Brettell Lane	Hall, Holcroft & Co.	1	1
Old Level	" "	1	1
Level	Lord Ward	2	1

<u>Name of Works</u>	<u>Proprietors</u>	<u>Furnaces in blast</u>	<u>Furnaces out</u>
Woodside	Cochrane & Co.	2	0
Netherton	M. & W. Grazebrook	1	1
Parkhead	Evers & Martin	1	1
Dixon's Green	J. Haden	1	1
Windmill End	Woodall & Smith	1	1
Withymore	Daves & Co.	1	1
Bumble Hole	New British Iron Co.	2	0
Dudley Wood	" "	2	2
Corngreaves	" "	2	0
Old Hill	T. & I. Badger	1	0
Willenhall	Fletcher, Solly & Co.	0	0
Stour Valley F's.	Richards & Co.	0	0
Darlaston	D. Jones	1	0
Birchhills	Heighway & Co.	0	0
Total		<u>126</u>	<u>32</u>

This list is taken from one in the Staffordshire Record Office (D 595/ Bundle 7); the details are those operating for December. A list, operating for September 1857, gives 155 furnaces in blast with 25 out of blast. Truran's figure (p. 173) for 1855 gives a total number of 169 furnaces, but he does not distinguish between those in and out of blast. J. Beele Jukes, in Memoirs Geological Survey of Great Britain (section on the South Staffordshire Coalfield) of 1858, gives a total of 182 furnaces built, 147 of which were in blast in that year.

State of the Pig Iron Department in 1864-5.

<u>Name of Works.</u>	<u>Furnaces Built</u>	<u>Furnaces in Blast</u>
Barber's Field, Bilston	2	2
Birchills, Walsall	2	0
New Birchills "	5	2
Bloxwich "	2	0
Bradley, Bilston	2	2
Brettell Lane, Stourbridge	2	2
Broadwaters, Wednesbury	3	2
Bovereux, Bilston	7	0
Bilston Brook "	3	2
Chillington, Wolverhampton	5	4
Moseley Hole	3	0
Bentley, Walsall	5	2
Capponfield, Bilston	3	3
Gold's Hill, West Bromwich	2	2
Conygree, Dudley	3	3
New Level, Brierley Hill	3	3
Cape, Smethwick	1	1
Corbyn's Hall, Dudley	4	3
Corbyn's Hall New, Dudley	4	2
Corngreaves, Birmingham	6	4
Coseley Hall, Bilston	2	2
Crookhay, West Bromwich	4	2
The Lays, Stourbridge	3	2
Darlaston Green, Wednesbury	3	3
Deepfields, Bilston	3	2
Dudley Port, Tipton	2	0
Dixon's Green, Dudley	1	1
Park Lane, Tipton	2	0
Dudley Wood, Dudley	3	2
Groveland, Tipton	1	1
Hallfields, Bilston	1	0
Hatherton, Bloxwich	2	1
Herbert's Park, Bilston	1	1
Horseley, Tipton	2	2
Ketley's, Dudley	4	0
Old Level, Brierley	2	0
Millfields, Bilston	4	3
Netherton, Dudley	2	2
Netherton New, Dudley	2	2
Stour Valley, Tipton	2	2
Oak Farm, Kingswinford	2	0
Oldbury	4	3
Old Hill, Dudley	2	0
Old Park Wednesbury	3	3
Osier Bed, Bilston	3	2
Park Head, Dudley	2	1
Parkfield, Wolverhampton	5	5
Belsall, Walsall	2	1
Priestfield, Wolverhampton	3	3
Priestfield, New "	2	0
Prior's Field, Bilston	3	2
Rough Hay, Darlaston	3	2
Russell's Hall, Dudley	5	1
Shut Ed. Kingswinford	4	3
Spring Vale, Bilston	3	2
Stonefield, Bilston	1	0
Stow Heath, "	4	2

<u>Name of Works.</u>	<u>Furnaces Built</u>	<u>Furnaces in Blast</u>	
Tipton	2	2	
Tipton Green	4	4	
Wednesbury Oak, Tipton	3	3	
Union, West Bromwich	3	3	
Willenhall	3	3	
Willingsworth, Tipton	3	2	
Wolverhampton	3	2	
Woodside, Dudley	3	2	
Withymoor, Dudley	2	2	
Windmill End, Dudley	3	3	
Total	191	123	*

\* Material taken from that supplied by J.Jones for the Birmingham meeting of the British Association. Some of the totals for individual sites have been amended where Jones' list was clearly at fault.

## Appendix 4.

State of the Pig Iron Department in 1880.

<u>Name of Works</u>	<u>Owners</u>	<u>Furnaces</u>	
		<u>Built</u>	<u>In Blast</u>
Barbor's Field	B.F. Company	2	1
Boveroux	Th. Holcroft	2	1
Deepfields	D. Iron Company	3	0
The Brook	The B. Furnaces Iron Company	3	0
Herbert Park	D. Jones & Sons	1	0
Priorfield	H.B. Whitehouse & Son	3	3
Millfield	W.& J. Sparrow & Company	3	1
Spring Vale	A. Hickman	4	4
Capponfield	J. Bagnall & Sons	3	1
Horseley Fields	Osier Bed Iron	3	0
Old Park	W/ton & Staffs Banking Company	3	0
Chillington	Ch. Iron Company	4	0
Golds Hill	J. Bagnall & Sons	3	2
Crookhay	H.O. Firmstone	4	0
Corbyn's Hall	W. Matthews & Company	3	1
Nektherton Ironworks	M&W. Grazebrook	2	1
Netherton Works	J.H. Pearson	2	2
Parkhead	Phillips & McEwen	2	1
Woodside	Cochrane & Company	2	2
Windmill End	Sir Horace St. Paul	3	1
Buffery	J. Jones & Son	2	1
Old Hill	N. Hingley & Sons	2	1
Corngreaves	New British Iron Co.	6	2
Old Level	J. Holcroft	2	0
New Level, Brierley Hill	Earl of Dudley	5	3
Coneygre, Dudley Port	" "	3	1
Lays, " "	W. & G. Firmstone	3	1
Shut End	J. Bradley & Company	4	1
Corbyn's Hall, nr. Dudley	Bromley Coal & Iron Co	4	0
Broadwaters, Wednes	S. Groucutt & Sons	3	1
Darlaston Steel & Iron	Darlaston S & I Company, Limited	1	0
Priestfields, New	W. Ward & Sons	2	0
Rough Hills	Addenbrook & Ptnrs.	3	1
Old Park,	Patent Shaft	3	0
Willingsworth Furnaces	W. Iron Company	2	1
Moxley	David Rose	2	0
Hatherton	G. & R. Thomas	2	0
Pelsall	Pelsall C.&I. Co. Ltd.	2	1
Green Lane	Walsall Iron Company	2	1
Bentley	Chillington Iron Co.	2	0
Willenhall	The W. Furnaces Ltd.	3	2
Castle	C. Coal & Iron Co.	2	0
Tipton Green	Roberts & Company	4	3
Hange	Round Brothers	2	1
Horseley	J. Colborn & Sons	4	1
Park Lane	" "		
Coseley Moor	T. Thurley & Sons	2	1
Wednesbury Oak	P. Williams & Sons	1	1
Groveland, Smethwick	G.H. Hickman	1	0
Brades Hall	W.&E. Onions	2	0
Park Lane	" "	2	0
Union Valley	Stour V. C.&I. Co.	3	0
Stonefield	Th. Crew	1	0
Total		137	45

APPENDIX 5

OLD PARK SCHOOL  
1865

28 Government Inspector's Report respecting Old Park School.—  
forwarded to us from Council Office, Downing Street—23 June 1865.—

"Discipline very good, Instruction satisfactory,"  
"considering that the Lock-Out and Colliers strike have made  
"against the School."

Account made for year ending 31<sup>st</sup> March 1865 as follows—

On average attendance 23. 0. 0

On examination ——— 26. 18. 8

Infants under 6 ——— 6. 6

Received June 23<sup>rd</sup> £ 50. 5. 2 by a Post Office order.



APPENDIX 6

RAILWAY AMALGAMATION - 1872

*Amalgamation* Railway Amalgamation - This subject deferred from last Meeting, was today considered when the following reply to queries by the Associated Chambers of Commerce was agreed on & the secretary instructed to send copy to the Association.

ASSOCIATION OF CHAMBERS OF COMMERCE,  
1, Great College Street, Westminster.  
21st March, 1872.

RAILWAY AMALGAMATION COMMITTEE.

Questions to be submitted to the Chambers of Commerce.

1. Are you opposed to the principle of railway amalgamation?

*Yes* - (1). Because in principle it abnegates the basis on which their privileges were understood to be given, viz. open competition - of which the inference is cheap rates - (2) It leads to a combined monopoly of which the inference is dear rates - and (3) as a trading company not under open competition the tendency of amalgamation as respects matters of convenience, comfort, despatch &c in travelling, will be to subordinate the interests of the Country to the interests of the proprietary. This will manifest itself in the indisposition to carry traffic to remote points of sparsely populated districts with despatch - equally in too infrequent passenger trains in such districts in particular - it will also check legitimate enterprise by hitherto competing companies by the extension of branch lines; the great amalgamated Company less caring to enter on even well projected extensions than to create possible "suckers" however inherently beneficial to the Country at large such extensions may be.

2. Will amalgamation injuriously affect your district? If so, in what respects?

As Railways in themselves are a Monopoly so Amalgamation of Railways is a combined monopoly, and on general principles we believe it would be injurious to the trade of this district. We are also further of opinion that a good case could be shown of our reasonable fear that the interests of this district would be prejudiced by amalgamation.

3. Do you anticipate that economical management will follow amalgamation?

Speaking generally this might be expected to follow. Amalgamations are however often delusive on this point.

Glossary of Black Country Terms.

All-mine pig	Pig iron made from ore; two qualities were made locally - <u>best</u> (local ores only) and <u>ordinary</u> (mixture of ores).
Part-mine pig	Pig iron made partly from ore and partly from cinder and/or scrap; sometimes referred to as <u>Cinder pig</u> .
Cinder	Slag from the blast furnace, puddling and mill furnaces. Referred to as <u>Taps</u> by some smelters.
Muck	Northampton ore.
Pottery	Ore from North Staffordshire.
'Flue'	Flue dust. Used by Hickman (and others) in the blast furnace and later as a fertiliser. The dust tended to settle under the furnace boilers and in the (Cowper) stoves.
Hot-cold	A blast furnace blown with a mixture of hot and cold blast.
Catcher	The back man at a stand of rolls. He catches the iron as it issues from the rolls, and sends it back ready for the next pass.
Heat	The working of a puddling furnace from the time it is charged until the cinder is cleared
Paddle	A chisel-ended tool used at the puddling furnace.
Rabble	A hook-ended tool also used at the puddling furnace.
List Houses	Makers of <u>marked bars</u> , i.e. the better qualities of bar iron. The Bloomfield Ironworks, for example, made a top quality bar iron which was marketed under the brand name "Crown BBH".

A fuller list of Black Country terms used by the local iron and steel industry is given by W.K.V. Gale, The Black Country Iron Industry, pp.166-89.

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